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Eastern Pacific Expeditions of the New York Zoological Society. XX.
Medusae of the Templeton Crocker and Eastern Pacific *Zaca* Expeditions, 1936-1938.[1]

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(Text-figures 1-20).

[This is the twentieth of a series of papers dealing with the collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of William Beebe. The present paper is concerned with specimens taken on the Templeton Crocker (1936) and Eastern Pacific *Zaca* (1937-1938) Expeditions. For data on localities, dates, nets, etc., refer to *Zoologica*, Vol. XXII, No. 2, pp. 33-46, and Vol. XXIII, No. 14, pp. 287-298.]

CONTENTS.

INTRODUCTION.

The medusae described in the following pages were collected by Dr. William Beebe on Mr. Templeton Crocker's Yacht *Zaca*, off Lower California and in the Gulf of California in April-May, 1936, and along the Pacific coast of Central America from Costa Rica to Panama in February-April, 1938. For data of the stations where medusae were taken on the first of these cruises (Stas. 139-165), see Beebe (1937); for those of the second cruise (Stas. 210-234), Beebe (1938).

The locations of the stations are shown on Text-figs. 1 and 2.
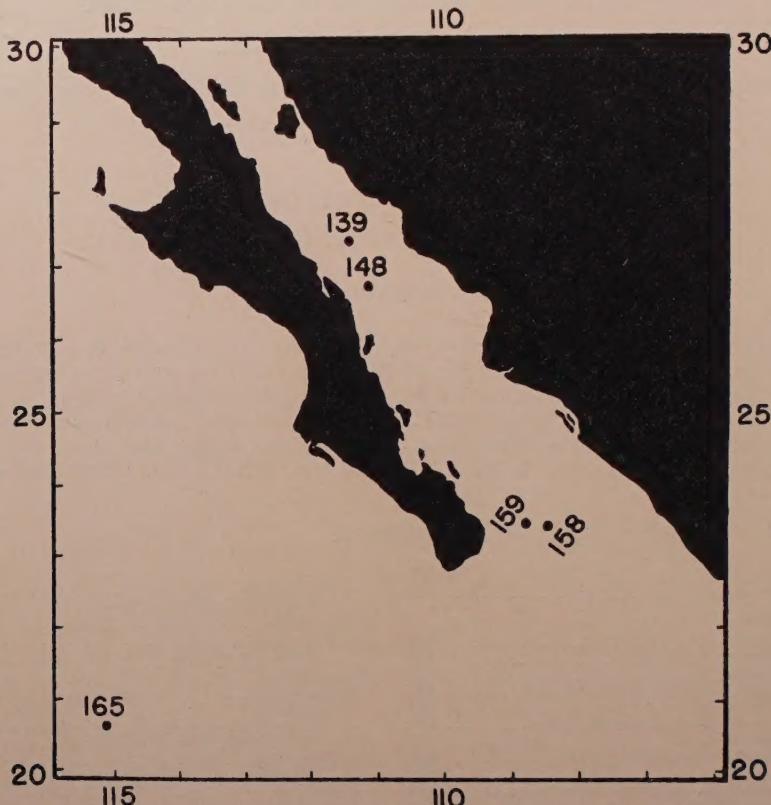
Text-fig. 1.
Locations of stations 139-158, April, 1936.

HYDROMEDUSAE.

ANTHOMEDUSAE.

Pandeidae.

Stomotoca.

Differences of opinion still exist as to whether the pandeids with only two large opposed tentacles, but many rudimentary tentacles, represent two genera, one with gelatinous peduncle (*Stomotoca*), the other without (*Amphinema*), or whether they properly form but a single genus, to which the name *Stomotoca* must be applied, on the grounds of priority. The latter
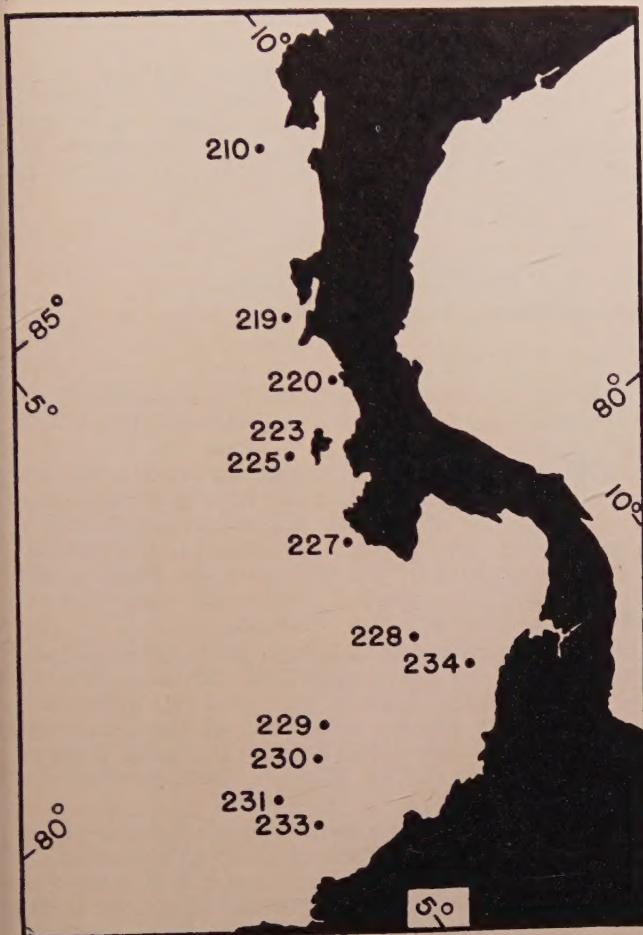
Text-fig. 2.

Locations of stations 210-234, February-April, 1938.

viewpoint has recently been adopted by Uchida (1927) and by Ling (1937), following Mayer (1910). To Hartlaub (1914), however, among others, to Russell (1938), and to me (1909, 1918), the presence or absence of a peduncle has seemed a character of generic importance, and is so considered here.

Stomotoca pterophylla Haeckel.

Stomotoca pterophylla, Haeckel, 1879, p. 52, Pl. 4, Fig. 10. For subsequent references and discussions, see Bigelow, 1918, p. 372; Ranson, 1936, p. 63.

Material: Sta. 229, surface, 1 specimen about 20 mm. in diameter: Sta. 231, surface, 1 specimen about 22 mm. in diameter, both in moderately good condition.

Comparison of series from the Florida-Bahaman region and from the Eastern Tropical Pacific has failed to reveal any significant difference between the Pacific *divisa* and the Atlantic *pterophylla* (Bigelow, 1918, p. 370); and this conclusion the present examples corroborate, for they agree in all significant respects with Maas' (1897) account of "*S. divisa*" from the Gulf of Panama, and with the *Albatross* series reported by me under that name

from the vicinity of the Galápagos and from the West coast of Mexico (Bigelow, 1909).

Records for the compound species in the Pacific are confined to the vicinity of the Galápagos, and along the west coast of America from southern Mexico to Colombia. In the Atlantic, however, its range appears to be more extensive, for it has been taken not only near Florida and the Bahamas in the western side (Haeckel, 1879; Mayer, 1910; Bigelow, 1918), but also in the central basin (Ranson, 1936).[2]

Leuckartiara.

Leuckartiara zacae sp. nov.

Text-figs. 3-5.

Material: Sta. 227, 910-0 meters, one specimen about 21 mm. high by 18 mm. in diameter, somewhat shrivelled in preservation, but otherwise in fair condition.

In 1916, Browne described, from the Indian Ocean, an interesting new pandeid (*Leuckartiara gardineri*), the generic identity of which was established by the structure of its gonads, but which differed from all known representatives of *Leuckartiara* in the presence of exumbral nematocyst-ribs extending upward over the surface of the bell from the bases of the tentacles. This character it shares with *Pandea conica* and with *Eutiara mayeri*, the gonads of which are, however, very different.

The present specimen, similarly referable to *Leuckartiara* by its gonads, recalls *gardineri* in the presence of exumbral ribs. And (so far as can be judged in optical section) these ribs, like those of *gardineri* and of *Eutiara mayeri* (Bigelow, 1918, p. 375), are canalar extensions of the tentacular bases, whereas in *Pandea conica*, Hartlaub (1913, p. 336) describes them as simply thickenings of the ectoderm. It differs, however, from *gardineri* in the following respects:

1. *Number of tentacles*: In the unique specimen of *gardineri*, there were only four large (perradial) tentacles and in addition about 24 rudimentary knobs, some with filaments, but others lacking the latter. And since the gonads contained fairly well-advanced ova, it seems probable that four is the final number of large tentacles in that form. In the *Zaca* specimen, however, there are (besides the four perradials) two or three other well-developed tentacles of different sizes per quadrant (a total of fifteen), each with corresponding exumbral rib, and also 1-3 rudimentary knobs (lacking fila-ments) between every two tentacles (Text-fig. 3).

2. *Number and length of exumbral ribs*: In Browne's specimen of *gar-dineri* there were four of these, one opposite each perradial tentacle and extending nearly to the apex of the bell. In the present example, in addition to the four perradials, there are 2, 1, 1 and 1 others in the different quad-rants, or a total of nine, each connected with a tentacle. And while four of the smaller tentacles lack them, exumbral ribs might later have developed in connection with these also. On the other hand, even the perradial ribs reach up only about ⅔ of the height of the bell, i.e., to about the level where the radial canals arise from the manubrial wall, while the others reach only to about the mid-level of the bell.

3. *Gonads*: These are considerably more complex than in *gardineri*, there being 8-12 primary folds, which bifurcate or trifurcate in each adradial series, as against 4-5 primary folds only—each bifid—per adradial series in *gardineri*. In *gardineri*, furthermore, the adradial series are united in

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[2] Ranson (1936, p. 64) states that the Monaco specimen was collected "au sud des Açores." But the position of the station in question (Monaco, Station 2115) is given as Lat. 31° 42′ N., long. 42° 40′ W., or roughly midway between the Azores and Bermuda.
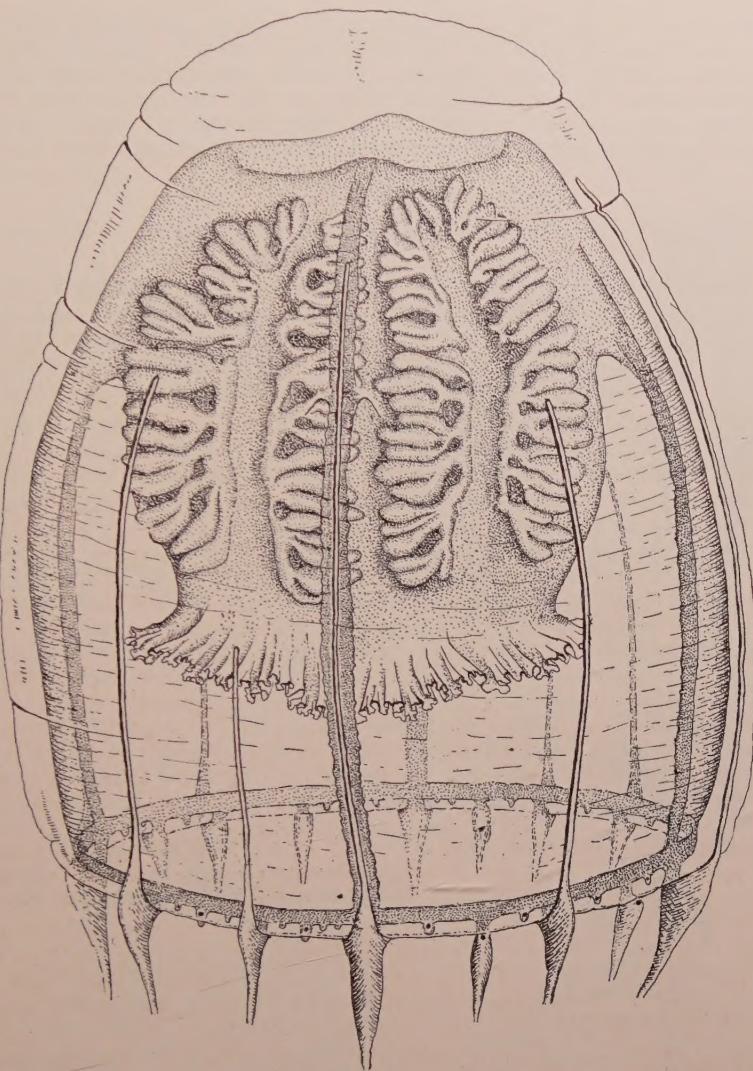
Text-fig. 3.
Leuckartiara zacae, sp. nov., type specimen, slightly restored.

each quadrant, by a transverse fold at about the mid-level of the manubrium (Browne, 1918, Pl. 39, Fig. 4), but this commissure is evident in one quadrant only of the *Zaca* specimen, suggesting that its presence represents a transitory stage in development. The specimen is apparently a male; at least no ova are visible in surface view.

Evaluation of these differences depends on whether the new-found specimen represents merely an advanced stage in the growth of a known species (all the differences being of a progressive sort), or whether it is a distinct species which, in its growth, passes through a stage in which it closely resembles the known form, but which attains to a greater degree of morphological complexity before reaching maturity. In the present instance, the available bases for decision are conflicting, for while the *Zaca*

specimen is about six times as large as the type of *gardineri* (suggesting an advanced stage in growth), the localities of capture for the two are on opposite sides of the globe. And since it seems important to emphasize the differences rather than to minimize them, so that the matter will be more searchingly examined by whomever is lucky enough to obtain additional specimens, a new specific name is proposed for the medusa under discussion here.
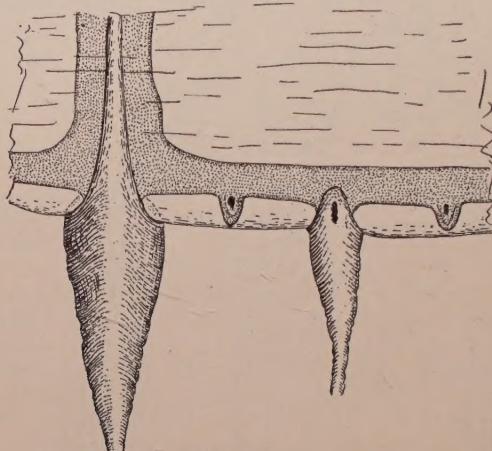
Text-fig. 4.

Leuckartiara zacae, sp. nov., margin with large and small tentacles, camera drawing, about × 14.
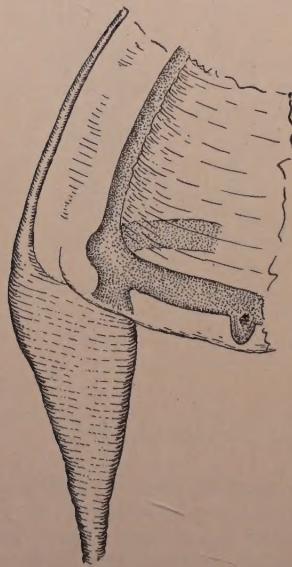
Text-fig. 5.

Leuckartiara zacae, sp. nov., lateral view of radial tentacle with nematocyst rib, about × 15.

Further points worth notice are that the tentacular bulbs are laterally flattened, clasping the exumbrella (as is usual in this genus), and that the tentacular knobs, as well as such of the fully formed tentacles as still lack exumbral prolongations, bear pigment spots on their abaxial sides. But the spots ("ocelli") are lacking on the tentacles in connection with which exumbral ribs have developed—apparently they are lost when the latter structures appear. The edges of the notably broad radial canals are slightly wavy; those of the ring canal smooth.

The ocelli are brick red, the manubrium and tentacular bulbs a pale salmon-color after preservation, which suggests a more brilliant reddish or pinkish hue in life.

Neoturris.

Neoturris crockeri sp. nov.

(Text-figs. 6-10).

Material: Sta. 234, 910-0 meters, 1 fragmentary specimen about 28 mm. high by about 32 mm. in diameter.

The unique example is so badly battered that reconstruction of the general form of the bell can be only tentative, further than that it is thin-walled throughout, without apical thickening, and apparently slightly broader than high. Fortunately, however, (though now in fragments) it still shows the chief anatomical characters.

At first glance, the specimen might easily be mistaken for a *Pandea rubra*, thanks to its dark chocolate-red pigmentation (see below). However, the structure of the gonads is quite different, being clearly of the *"Neoturris"* type as defined by Hartlaub (1914). More precisely, each perradial belt is flanked, on either hand, by a series of transverse folds of various sizes (Text-fig. 6). As is typical of *Neoturris*, the sexual folds are not connected one with another at their interradial ends, but are entirely independent. But the interradial zone of the manubrial wall, between each two series of folds, is occupied by a series of small irregular ridges—primarily longitudinal—alternating with recesses. Comparison of Text-fig. 6 with Hartlaub's (1914, p. 35, Fig. 273) picture of the manubrium of *N. pileata* will show the essential similarity. However, while the adradial folds are simple in one of the quadrants (Text-fig. 6), in another adjacent (Text-fig. 7) they are so complexly split and cross-furrowed that it is impossible either to distinguish between primary folds and secondary, or even, in the extreme case, to distinguish sharply where adradial folds give place to interradial mesh-work. Locally, then, the *"Neoturris"* state grades into the *"Pandea"* state. Nowhere, however, does it grade into the *"Leuckartiara"* state, i.e., that in
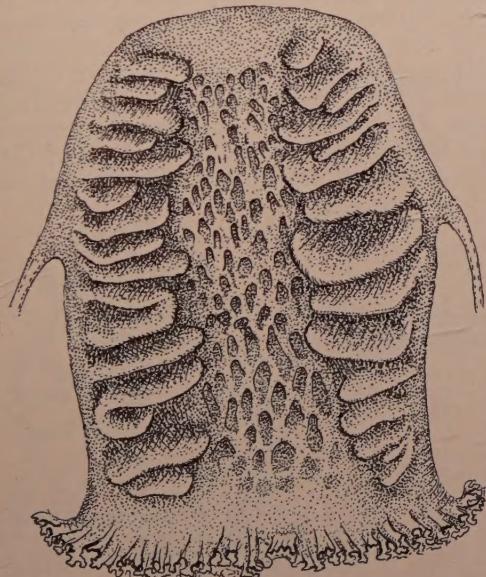
Text-fig. 6.

Neoturris crockeri, sp. nov., interradial view of one quadrant of manubrium to show gonads, somewhat restored.

APICAL

PER.   INTER.
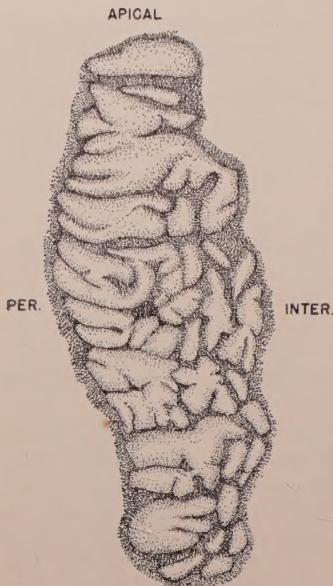
Text-fig. 7.
Neoturris crockeri, sp. nov., adradial series
of sexual folds in quadrant adjacent to that
shown in Text-fig. 6. Camera drawing.

which the interradial extremes of the transverse adradial folds are con-
nected. The specimen is a female, the sex folds packed with large eggs (Text-
fig. 8)—and scattered eggs are to be seen in the interradial belts, as well.
It is interesting, as an example of a fate that no doubt causes an appre-
ciable destruction of medusan eggs, that in the present case a considerable
number are to be seen within the radial canals.

The relationship of radial canals to manubrium is of the type charac-
teristic of the more complexly organized pandeids (*Neoturris, Pandea,
Leuckartiara, Catablema*), for the so-called "mesenteries" are so well devel-
oped (Text-fig. 6) that the canals depart from the manubrium at about
the mid-level of the latter. Above this level, consequently, the bell cavity is
subdivided into four extensive pockets by the lines of attachment between
the manubrium and subumbrella.

The canals themselves are broad, flat (as usual in this family), their
edges nearly smooth—or at most but slightly irregular. And this applies
equally to the margin of the ring canal. The manubrium occupies the greater
part of the bell cavity, hanging in its present state about to the level of the
bell opening. The lips are complexly crenulated, much as in *Pandea rubra*.

Text-fig. 8.
Neoturris crockeri, sp. nov., portion of one
of the sexual folds packed with ova, camera
drawing, × 60.
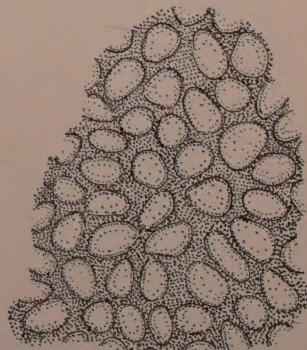
There are 38 tentacles, the numbers in successive quadrants being 10, 9, 9, 10, of various sizes (Text-fig. 9). Presumably this would have been the final number in this particular specimen, for there are no additional rudiments or knobs. The tentacle bases, broadly triangular in side view (Text-fig. 10), and laterally compressed, clasp the exumbrella, as is so commonly the case in this family, and taper gradually to slender filaments.

There is no trace of exumbral ridges connected with the tentacles. And since the surface of part, at least, of the bell is in fair condition, there is no reason to suppose that such structures were present in life, but had been destroyed. Neither are any ocelli to be seen.

The most interesting feature of this specimen is its bathypelagic coloration, the manubrium as a whole being of a dense reddish-chocolate hue, paling at the lip, and with the opaque white eggs showing through the overlying, pigmented ectoderm, much as do the larger eggs of the Narcomedusa, *Aeginura grimaldii*. The bases of the tentacles and a narrow peripheral belt of the subumbrella are sparsely pigmented with the same hue, the pigment granules in the latter cases so large and loosely spaced as to be individually visible under low magnification. The remainder of the subumbrella is faintly tinged, though without visible granules.
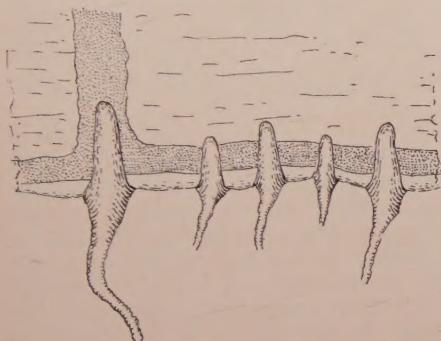
Text-fig. 9.

Neoturris crockeri, sp. nov., segment of margin to show the tentacles of different sizes, about × 7.5.

Superficially, as noted above, this specimen most resembles *Pandea rubra* among known pandeids. However, the tentacles are considerably more numerous, the maximum yet recorded for a considerably larger specimen of *rubra* being only 20 (Bigelow, 1938, p. 107). More important, the structure of the gonads proves that the resemblance to *Pandea rubra* is only super-
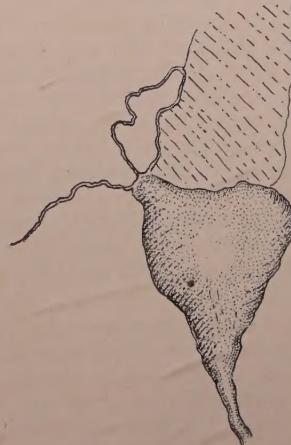
Text-fig. 10.

Neoturris crockeri, sp. nov., lateral view of one of the medium-sized tentacles.

ficial and that we are actually dealing with a *Neoturris*. However, it differs from all known pandeids in which the gonads are definitely known to be of the *"Neoturris"* type, not only in its peculiar pigmentation, but also in the facts that the radial canals are smooth-edged, and that the tentacular organs, large or small, are so few in number and consequently so widely spaced. A new species seems therefore necessary for its reception.

The depth of capture of the type (and so far only known) specimen (910-0) argues, as does its color, that it is a member of the bathyplankton.

Calycopsis.

Up to the present time, eleven supposed species have been referred to this genus or to *Sibogita*, now generally considered synonymous with it. The necessity of decision as to the status of its representative in the *Zaca* collection makes this an opportune time to summarize the features by which the several named members of the genus have been separated one from another. Critical revision (depending on the evaluation of variability) must, however, await the accumulation of larger study series.

One of the species, *birulai* Linko (1913), can be omitted from the discussion, on the ground that it does not belong to this genus, but is more closely allied to *Eumedusa similis* (Bigelow, 1920). It may, in fact, prove identical with the latter, in which case Linko's specific name would take precedence.

For the remaining members of *Calycopsis*, the following characters have been chiefly emphasized as specific: 1, number of tentacles and canals and their interrelationship; 2, arrangement of centripetal canals and the degree to which these finally fuse either with one another, with the radials, or with the base of the manubrium; 3, morphology of the gonads; 4, presence or absence of labial nematocyst knobs; 5, whether or not the radial canals are dilated at their points of emergence from the manubrium to form so-called "mesenteries"; 6, presence or absence of gelatinous exumbral papillae on the marginal lobes of the bell; and 7, presence or absence of a funnel-shaped apical exumbral depression. Among these characters, the presence of an apical depression in *typa*, of labial nettle knobs in *nematophora*, and of prominent papillae on the exumbral surfaces of the marginal lobes in *papillata*, in *valdiviae*, and in at least one of the specimens in the collection of the German South Polar Expedition (taken near the Cape Verdes), that were recorded by Vanhöffen (1912) as *"typa,"* contrasted with their absence elsewhere, is strictly alternative. The presence or absence of subumbral muscle bands along the radii of the tentacles, and of pigment spots at the bases of the tentacles, also appears to be alternative at least between certain of the named forms. Similarly, the conformation of the gonads is of two rather sharply opposed types, for while in *borchgrevinki* (at least in the male), the sex products develop in pockets of the manubrial wall, and open to the exterior by small pores (Browne, 1910; Vanhöffen, 1911, p. 216, Fig. 10a; Mackintosh, 1934), the gonads of all other known members of the genus form double rows of transverse folds, occupying the interradial sectors of the manubrium, the minor divergences being that in *nematophora*, small irregular folds occur between the chief series, and that in *typa*, the gonads bear egg-shaped swellings, scattered here and there (Bigelow, 1909a, Figs. 1, 2).

Other characters are less sharply discontinuous. Thus, *chuni* with 36-27 canals, *geometrica* with 32-22, *typa* with 21-16, and *nematophora* with 18-16 form a continuous series. In *valdiviae*, however, the number of canals recorded (60) is some 20 greater than in any other known *Calycopsis;* in *bigelowi* and in *simplex*, it may be permanently smaller (8). In *simulans* and in *papillata*, the number (12 in each case) appears to be determinate,

probably also in *borchgrevinki* (16), whereas in most, at least, of the other supposed species it is variable. In *simulans* and *papillata*, furthermore, the centripetal canals are all adradial, whereas in all other named forms in which the metameral arrangement has been determined, there is an interradial canal in each quadrant with or without adradials according to the number of centripetals peculiar to the particular species in question. In this respect, *typa* is especially unstable for there may be 2, 3, or 4 canals in adjoining quadrants (Bigelow, 1909a), beside the interradial member. Ordinarily the centripetals arise singly from the ring canal. In *typa*, however, they may exceptionally arise in pairs (Bigelow, 1909a, Fig. 7), while in *chuni* they may be either single or in groups of two or three (Vanhöffen, 1911, p. 218, Pl. 22, Fig. 8).

In previous discussions of the genus, much emphasis has been laid on the endings of the centripetal canals, i.e., whether permanently blind, or whether finally fused with the radial canals, or with the cruciform base of the manubrium. In *bigelowi*, in *simplex*, and in such of the specimens recorded as *typa* as seem properly to have belonged to that species, the canals are described as ending blindly—in the latter case even in a specimen 37 mm. high with large ova (Bigelow, 1909a, p. 290). In *simulans* and *valdiviae* some at least join the base of the manubrium, but others (by present indications) may remain permanently blind, which according to Browne (1910, p. 17) also applies to *borchgrevinki*. In *nematophora* all come finally to join the base of the manubrium—a junction interpretable in some cases as with a radial canal at its point of origin from the manubrium (Bigelow, 1913, Pl. 3, Fig. 24). In *papillata* they all end blindly in medium-sized specimens, but in the largest (27 mm. high, with eggs), two were still blind, "but of the remaining six, three have joined the cruciform base of the manubrium; two join radial canals close to their bases, and one joins a radial canal at a considerable distance from the manubrium" (Bigelow, 1918, p. 280, Pl. 2, Fig. 1). This specimen thus bridges the gap between the foregoing group and *geometrica*, in which all the centripetals unite with the radials at different levels.

The numbers of tentacles in the different members of *Calycopsis* overlap to a greater degree than do the numbers of canals, the total range (60-8) being practically covered by three species, *nematophora* (57-30), *typa* (30-16), and *borchgrevinki* (8-16). Recorded numbers of tentacles for the other supposed species are: *valdiviae*, about 60; *bigelowi*, 48; *chuni*, 16-17; *geometrica*, 16-22; *simulans*, 12-18; *papillata*, 12; *simplex*, 8.

As appears from the foregoing, the canals and tentacles may be equal in number (a tentacle opposite every canal); they may be either equal in number or the tentacles the more numerous (*simulans*); the tentacles may be characteristically the more numerous (*borchgrevinki, bigelowi, nematophora, typa*); or the canals the more numerous (*geometrica, chuni*).

In *typa*, it appears that the tentacles develop before the corresponding canals appear; apparently also in *nematomorpha*, hence this is likely the general rule, except in forms in which the final number of canals is greater than that of the tentacles.

Taxonomic evaluation of labial knobs and of gonad-structure presents no difficulty, for these both appear of full specific import. Thus, *nematomorpha* is set apart from all other members of the genus by the presence of the former, as well as by the presence of subumbral muscle bands along the canalar radii; *borchgrevinki* by the gonads. The presence of a well-marked apical exumbral depression, coupled with an evident tendency for the centripetal canals to continue blind, even at maturity, is a good mark of identification for *typa*, for while the depression might seem a trivial feature, its presence, not only in Fewkes' (1882) original specimen, but also in others collected many years later by the *Grampus*, and in five more in the

Arcturus collection (all from the same general region off the northeast coast of the United States) seems to establish its constancy.

Geometrica is equally marked off by one outstanding character, i.e., by the union (in the adult) of all the centripetal canals with the radials. The only other *Calycopsis* that at all approaches it in this respect (*papillata*) has well marked exumbral sculpture which *geometrica* lacks.

Simulans and *typa* form a natural group so far as general appearance is concerned—so closely, in fact, do they resemble each other that Vanhöffen (1911) classed the former as a synonym of the latter. However, all the specimens referable to *simulans* that have so far been seen (including the *Zaca* specimen described below) have differed from typical *typa* not only in lacking any trace of apical depression, or of the egg-shaped swellings on the gonads that appear characteristic of the latter, but also in the fact that for them the number of canals appears to be determinate (12) instead of variable. Among the examples of "*simulans*" so far recorded, one from the Philippines (Bigelow, 1919) is set apart by the facts that most of the centripetal canals are fused with the manubrium instead of ending blindly, and that there are eight small tentacles in addition to the twelve that correspond to the canals. Whether this represents a geographic variation—i.e., that development progresses further in this respect in one race of *simulans* than in another—or whether the Philippine example actually belongs to some form as yet unnamed, is a question for the future.

Chuni, to judge from Vanhöffen's (1911, Pl. 22, Fig. 8) picture, must be grouped in its general organization with the *typa-simulans* group. However, its canals (27, 36) are somewhat more than twice as numerous as its tentacles (16, 17), whereas in *typa* and in *simulans*, the tentacles are at least as numerous as the canals. *Valdiviae* (to judge from the only adult yet seen) is set apart by the very large number (60) of canals, just commented upon, combined with absence of mesenteries. In *bigelowi* the numerical ratio of tentacles (48, large and small) to canals (8) is much larger than in any other member of the genus. And while the small size of the one specimen so far seen (only 12 mm. high) might suggest that it was a juvenile, the well-developed gonads argue against this view. Vanhöffen's (1911, p. 218, Fig. 12) illustration also suggests that part of the tentacles remain permanently small. *Simplex*, finally, while agreeing with *bigelowi* and *borchgrevinki* in the small number (8) of canals, is separated from the former by the fact that it has only about ⅙ as many tentacles (8), and from the latter by the structure of the gonads. It may be the juvenile of some other form.

It appears, in short, that while the various named members of the genus are closely allied, one to another, most, at least, of them differ sufficiently to be accepted as good species until intermediates be actually found. Their geographic distribution tends to strengthen this conclusion. Thus, specimens with apical depression (*typa*) have been taken only off the continental slope of North America; those agreeing with the original specimens of *simulans* only off the west coast of Central America; those with labial nematocyst knobs (*nematomorpha*) only in the Bering Sea region; those with the *borchgrevinki* type of gonads only in high southern latitudes; those with the *geometrica* type of canalization are known only in the Philippines and East Indies; the *simplex* type only from Norway; those of the *bigelowi* and *chuni* types from the Gulf of Aden.

Specimens with warty marginal lobes have, it is true, been recorded widespread, i.e., from the Florida-Bahamas region (*papillata*, Bigelow, 1918), from the vicinity of the Cape Verde Islands (Vanhöffen, 1912), and from the Alguhlas current by Vanhöffen (1911) as "*typa*," this last being the specimen on which Hartlaub (1914) subsequently founded the species *valdiviae*. But *papillata* and *valdiviae* differ so widely in other respects (as

emphasized above) that there can be no question of their identity. And the description of the other warty specimens recorded by Vanhöffen (1912, as "*typa*"[3]), classed tentatively by Hartlaub (1914) as juveniles of *valdiviae*, are not detailed enough for positive identification.

The following artificial key to the species of *Calycopsis* may be helpful for purposes of identification:

1. With labial nettle knobs and subumbral muscle bands.... ....

   nematophora Bigelow

   Without labial nettle knobs or subumbral muscle bands.................2

2. All centripetal canals join the radial canals at various levels.....................

   geometrica Maas

   Most of the centripetal canals either end blindly, or join the cruciform base of the manubrium............. 3

3. With about 60 canals at maturity...................................*valdiviae* Hartlaub
   With 40 canals, or fewer..4

4. Gonads in pockets..*borchgrevinki* Browne
   Gonads in exterior folds.... 5

5. Exumbrella with well-marked apical depression....................*typa* Fewkes
   Without apical depression 6

6. Many more canals than tentacles...........................*chuni* Vanhöffen
   Tentacles at least as numerous as canals...7

7. Marginal lobes with well-marked exumbral papillae.........*papillata* Bigelow
   Marginal lobes smooth or nearly so..8

8. Many more tentacles than canals...................*bigelowi* Vanhöffen
   Number of tentacles and canals about equal..9

9. Centripetal canals all adradial..*simulans* Bigelow
   Centripetal canals interradial..................*simplex* Kramp & Damas

Calycopsis simulans Bigelow.

Sibogita simulans, Bigelow, 1909, p. 213, Pl. 5, Figs. 4, 5; Pl. 41, Figs. 8, 9; Pl. 43, Figs. 1, 2; 1913, p. 21; Mayer, 1910, p. 187.

Calycopsis simulans, Hartlaub, 1913, p. 360; Bigelow, 1918, p. 377.

Calycopsis typa (Partim), Vanhöffen, 1911, p. 214.

? *Calycopsis typa* var. *simulans*, Bigelow, 1919, p. 292, Pl. 40. Fig. 8; Pl. 41, Fig. 1.

Material: Sta. 233, 910-0 meters, one specimen, in good condition, about 26 mm. high by 25 mm. broad.

The *Zaca* capture corroborates the evidence afforded by the two specimens from between Panama and the Galápagos, for which the species was originally established, that the final number of canals in *simulans* is 12, i.e., 2 centripetals in each quadrant. In the original specimens these all ended blindly, though in their growth they had reached nearly to the cruciform base of the manubrium[4]. And this is true also of the *Zaca* specimen, though in this case the canalar terminations come so close to the manubrium that careful examination was required to demonstrate the discontinuity. It also agrees with the type specimen in the presence of as many large tentacles (12) as canals, one of the former opposite each of the latter. The fact that specimens apparently adult (to judge from the gonads) from

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3 Among three juveniles recorded as *typa*, two from the tropical Atlantic and one from the Indian Ocean, Vanhöffen (1911, p. 364) states that the wartiness was especially prominent after alcoholic preservation, which identifies the specimens as above.

4 As pointed out elsewhere (Bigelow, 1913, p. 23), it is probable that a specimen from Bering Sea originally referred by me to *simulans*, in which the canals all join the manubrium (Bigelow, 1909, p. 214, Fig. 2), actually belonged to *C. nematomorpha*.

the same general region, but taken 32 years apart, agree so closely in these respects makes it likely that this is the final state. And for this reason it may finally prove necessary to find a new name for the Philippine specimen, originally described by me (1919) as var. *simulans* of *typa*, but in which all but one of the centripetals had already fused with the manubrium though the medusa was only 16 mm. in diameter, and in which there were eight small tentacles, besides the twelve larger ones connected with the canals (p. 292).

I need only note further that the tentacles, like those of the original specimens—of most other members of the genus, in fact—are tipped with prominent nematocyst knobs; that the sexual folds correspond closely to those of the type in regularity and general arrangement, and that there is no trace either of an apical depression or of exumbral papillae on the marginal lobes.

In the preserved condition the manubrium is pale ochre, the tentacles colorless.

The fact that the *Albatross* specimens were taken at the surface makes it likely that the present example was picked up by the net at a small depth, either on its way down, or its way up.

Bougainvilliidae.

Chiarella.

Chiarella centripetalis Maas.

(Text-figs. 11, 12).

Chiarella centripetalis, Maas, 1897, p. 15, Pl. 2, Figs. 1-4; 1905, p. 13; Mayer, 1910, p. 182; Foerster, 1923, p. 29.

Material: Stas. 139, 148, 159, in hauls respectively from 549-0, 549-0, 910-0 meters, 5 specimens, about 20-25 mm. high.

This large and easily recognized species had not been reported since originally described by Maas (1897) from specimens taken in the Gulf of California in 1891 by the U. S. Fish Commission Steamer *Albatross*. The
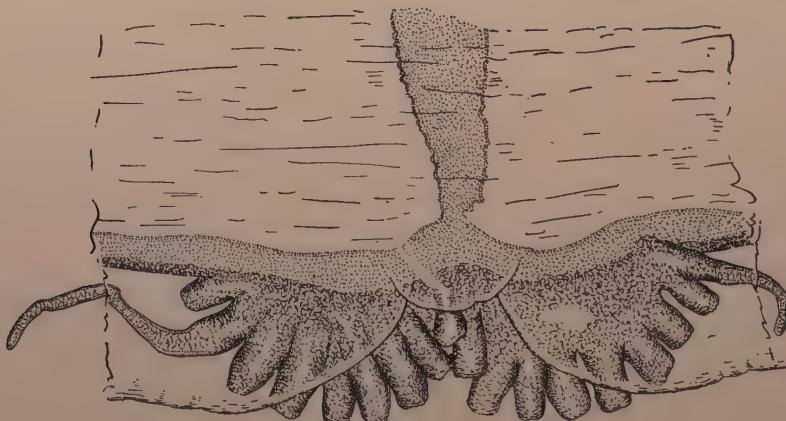

Text-fig. 11.

Chiarella centripetalis Maas, from Sta. 159, radial group of tentacles, camera drawing, about × 13.

Zaca captures in the same general region are, therefore, of considerable geographic interest.

The specimens, though all more or less damaged, are in good enough condition to show that in most respects they agree with Maas' account so closely that there is no doubt of their specific identity. This applies, in particular, to the general form of the bell; to the outlines and lengths of the spur-like interradial centripetal canals (Text-fig. 12), to the conformation of the gonads and to the basic arrangement of the eight groups of tentacles, by which the genus is characterized. Conspicuous, in particular, is the epaulette-shape of the basal folds from which the tentacular filaments arise (Text-figs. 11, 12), and the adradial series of transverse sex folds in the manubrial wall, which, in two of the *Zaca* specimens, are packed with large eggs.

The peduncle is considerably longer in four of the five *Zaca* specimens (the condition of the fifth is not good enough to show this) than in Maas' (1897) illustration based on a sketch from life, occupying in the extreme case, about ⅓ of the length of the bell cavity. But as there is a considerable variation in this respect within the series, and as all of them are in a flaccid condition in weak formalin, it is probable that this apparent difference between the collections of 1891 and of 1936 is the result either of different states of contraction or of preservation.

It is also worth mention that the margins of the radial canals (at least in the better-preserved examples) are slightly irregular or wavy though never definitely lobed—a feature not mentioned by Maas. The ring canal is smooth-edged.
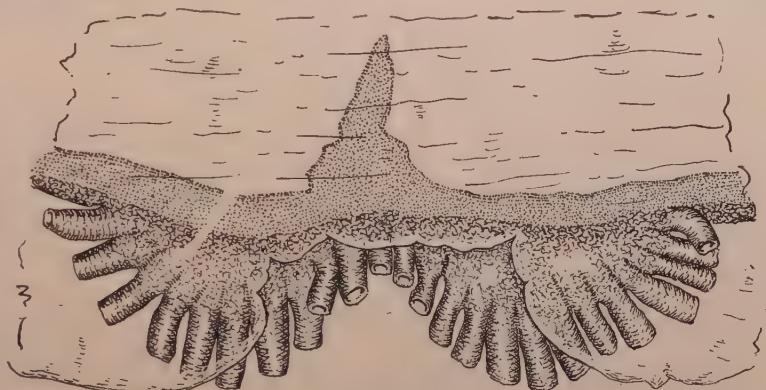
Text-fig. 12.
Chiarella centripetalis Maas from Sta. 139, interradial group of tentacles, camera drawing, about × 16.

According to Maas (1897, p. 16) there are about as many tentacles in the interradial groups as in the radials (more than 40 in each, a total of more than 320). However, he does not state whether an individual count was made of any group other than the one pictured. And the *Zaca* series proves not only to be more variable in this respect, but with the number averaging only about half as great in specimens of the same size, the numbers being as follows for the groups for which counts are possible:

APPROXIMATE BELL HEIGHT	RADIAL GROUPS	INTERRADIAL GROUPS
24 mm.	19, 19, 20, 18	16, 16, 17, 19
23 mm.	18, 19	16, 25
21 mm.	22, 22±, 25±, 33±	24, 23, 31, 38±
20 mm.	23±, 24±, 24±	28±, 27±, 24, 24±
25 mm.	not more than 20 in any group	

The spacing around the bell margin is also variable, for while in the 24 mm. and 25 mm. specimens, all the epaulettes are approximately equal in breadth and of approximately the same breadth as the interspaces, in the 21 mm. specimen the interradial group with 38 tentacles occupies practically the entire interspace between the two adjacent radial groups.

Maas remarked that "die einzelnen Fäden sind verhältnissmässig kurz, was nicht auf Rechnung ihrer Contraction zu setzen ist, wie Skizzen nach dem Leben zeigen" (Maas, 1897, p. 16). Similarly, in the *Zaca* series all the more central members of each group are not only mere stumps (Text-figs. 11, 12) but such of them as are in good condition are rounded at the ends. But in several of the better-preserved groups the one or two tentacles near the outer margin extend as well developed though short filaments (Text-fig. 11), suggesting that all the tentacles may have been extensible to at least this extent in life.

According to Maas there is an ocellus at the base of each tentacle, as also appears in his color sketch from fresh material (Maas, 1897, Pl. 2, Fig. 1). These are not visible on the *Zaca* specimens, but they may have faded in the preservative.

In the preserved state the manubrium varies between dull salmon-pink and ochre yellow; the tentacular pads are of various shades of reddish-yellow.

The original account includes no information as to the depth of capture. But the fact that all of the *Zaca* specimens were taken in hauls from considerable depths suggests that the normal habitat lies considerably below the surface.

LEPTOMEDUSAE.

Thaumantadidae.

Polyorchis.

Polyorchis penicillata Eschscholtz.

Melicertum penicillatum, Eschscholtz, 1829, p. 106, Pl. 8, Fig. 4.
Polyorchis penicillata, A. Agassiz, 1862, p. 349.
To the synonymy given by Mayer, 1910, p. 218, add
    P. penicillata, Foerster, 1923, p. 32; and
    P. minuta, Murbach & Shearer, 1902, p. 72; 1903; p. 174, Pl. 19,
        Fig. 3, Pl. 22, Fig. 1.

Material: Inez Bay, 1 specimen about 10-12 mm. in diameter.

In this specimen, less than half grown to judge from the size to which the species attains in Californian waters (Mayer, 1910, p. 218; Foerster, 1923, Table, p. 34) there are 31 well developed tentacles, as well as three (or perhaps four) rudimentary tentacular knobs; or a number nearly as great as given by Mayer for the adult. However, Foerster (1923, p. 32) records an average of 64 tentacles (or 16 per quadrant) for large specimens, suggesting that the *Zaca* example was about half grown as regards number of tentacles as well as in size.

According to Fewkes (1889) and to Foerster (1923) the edges of the radial canals already bear small projections even as early as the 16-tentacle stage, foreshadowing the lateral diverticula characteristic of the adult *Polyorchis*. And the latter author (1923, p. 34) records their number as "fairly constant, i.e., 30-40, for small as well as for large specimens." In the *Zaca* example the edges of the canals are at most slightly wavy, at a stage in growth at which Californian specimens show well developed diverticula. Since, however, this is the only feature differentiating this specimen

from its confreres in more northern waters, it does not seem sufficient to warrant even a distinct racial name.

Previous records for *Polyorchis penicillata* were wide-spread between northern Vancouver Island and Santa Barbara, California. The *Zaca* capture is interesting chiefly for extending the known range of the species southward to the Gulf of California.

LAODICEIDAE.

Chromatonema.

I have recently (1938, p. 109) given reasons for retaining this genus among the Leptomedusae as a member of the Laodiceidae, rather than classing it among the Anthomedusae as Ranson (1936) has done. The reader is also referred to Kramp (1919, p. 14) for discussion of the differences in gonad structure between *Chromatonema*, in which the gonads are broken up into a series of discontinuous masses, and in *Ptychogena*, where the gonad developed along either side of the pinnate radial canal is continuous. Named forms referable to *Chromatonema* as defined by Kramp (1919) are *rubrum* Fewkes, from the north Atlantic, *erythrogonon* Bigelow from the eastern tropical Pacific, and *hertwigi* Vanhöffen from the Indian Ocean. These are so closely allied that they may finally prove to be races or local varieties of one wide ranging species, but the recorded differences seem sufficient for the retention of all three names, at least for the time being.

Chromatonema erythrogonon Bigelow.

Text-fig. 13.

Ptychogena erythrogonon, Bigelow, 1909, p. 150, Pl. 5, Fig. 1; Pl. 38, Figs. 8, 9; Pl. 39, Figs. 1-7; Vanhöffen, 1911, p. 220.
   Chromatonema erythrogonon, Kramp, 1919, p. 11; 1933, p. 553.
   *Chromatonema rubrum* (Partim), Ranson, 1936, p. 102.
   Chromatonema rubrum var. *erythrogonon*, Ranson, 1936, p. 105.

Material: Stas. 139, 148, 219, 228, 244, in hauls from 910 and 914-0 meters, a total of 14 specimens ranging in diameter from about 15-16 to about 44 mm., all of them in more or less fragmentary condition.

The *Zaca* series corroborates Kramp's (1919, 1920) conclusion, based on the original account of *erythrogonon* (Bigelow, 1909), that the latter agrees in all important anatomical features (as it does in general appearance, including color) with the Atlantic *C. rubrum*. Microscopic examination of the marginal organs in the *Zaca* specimens, and reexamination of the original material of *erythrogonon*, also shows that absence of nematocysts in the cordyli of *erythrogonon*—mentioned by Kramp (1919, 1920) as a possible distinction—is only apparent, i.e., that my earlier illustration (1909, Pl. 38, Fig. 8) was faulty in this respect. Actually (Text-fig. 13), the tips of the cordyli are crowded with minute, fusiform nematocysts in the Pacific form, just as in the Atlantic. And Kramp was no doubt correct in considering what I named "cirri" (1909, Pl. 38, Fig. 9) for *erythrogonon* as identical with the cylindrical cordyli in *rubrum;* especially since one *Zaca* specimen bears two cordyli intermediate between the two extremes; whereas in none of them have I been able to detect anything that could be described as a "cirrus."

It appears, however, that on the average the Pacific form develops a somewhat larger number of tentacles than does the Atlantic. True, the discontinuity—if such exists—is not wide, for the largest (44 mm.) of the *Zaca* specimens and two others of 35-40 mm. have each 38-39 tentacles,

contrasting with a maximum of 20-24 in *C. rubrum* (maximum 7-8 per quadrant, Kramp, 1933, p. 552). But occasional specimens from the Pacific have considerably larger numbers, witness one *Zaca* specimen in which 57 can still be counted, also the presence of as many as 16 in a single quadrant of one of the original *Albatross* specimens, suggesting a maximum of perhaps 60-64, or a number 2-3 times as large as has yet been recorded for any specimen from the Atlantic. The variability in different sectors of the margin is further illustrated by one of the *Zaca* series (40 mm., Sta. 239) in which there are 6, 8, 13, and 11 or 12 in successive quadrants. The number of cordyli is also greater in *erythrogonon* than in *rubrum*, i.e., not far from 60 in specimens so far studied. However, there is no discontinuity in this respect between the two forms, the recorded maximum being up to 40-45 in *rubrum,* in which there are more often 2 than 1 between every tentacle, and sometimes no greater than this in *erythrogonon* in which there is more often 1 than 2 in each intertentacular gap. In the largest of the *Zaca* specimens, for example, with 38 or 39 tentacles, there is one cordylus, each, in 19 of the gaps, and 2 each in 14 of the gaps, i.e., a total of approximately 40. In another specimen the numbers in successive gaps were 1, 1, 1, 1, 2. However, three were observed in one gap.
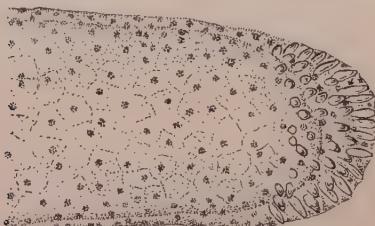
Text-fig. 13.

Chromatonema erythrogonon Bigelow, surface view of tip of cordylus to show nematocysts, from a preparation stained in Delafield's haematoxylin, camera drawing, about × 350.

On the other hand, it appears that the number of sexual masses may average slightly smaller in *erythrogonon* than in *rubrum* (again, however, there is no discontinuity!), for in the latter this varies from 10-16 on either side of each radial canal (Kramp, 1933, p. 552), whereas among the *erythrogonon* so far seen, that were in good enough condition for the number to be determined, the maximum was 11, and most frequently 9 or 10. A minor difference that the future may or may not prove characteristic is that in *rubrum*, so far as known, the free-hanging portion of the manubrium is quadrate, but barrel-shaped in *erythrogonon*. It also appears that at maturity, *erythrogonon* tends to attain a larger size (up to 44 mm.) than does its Atlantic relative (recorded maximum, 27 mm.).

Vanhöffen's (1911) *hertwigi* from the Indian Ocean—if the single specimen was representative—appears to be characterized by a much larger number of cordyli[5] (5) between every two tentacles than has ever been recorded, either for *rubrum* or *erythrogonon*. It agrees with the former, however, in the fact that the mouth was distinctly quadrate, and also in the number (20) of tentacles although it was much larger in size, i.e., 50 mm. in diameter.

The *Zaca* specimens are not in good enough condition to add anything important (other than as above) to the earlier account of *erythrogonon*. They do, however, provide interesting evidence of the constancy of coloration in this species, the tentacular bulbs, manubrium, and distal parts of the radial canals of the one specimen that is in good enough condition to show these being of the same brick-red (pale along the lines of attachment to the subumbrella and with pale cross at the base of the manubrium) and

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[5] Vanhöffen names them "cirri," but his illustration (1911, p. 220, Fig. 13b) shows that actually they correspond to the cordyli of other members of *Chromatonema*.

the sexual blocks of the same salmon-pink as in the original series. In fact, all known representatives of *Chromatonema* agree in this respect.

The geographic range of *C. erythrogonon* appears to be decidedly circumscribed, for it has so far been taken only off the coasts of South and Central America between Latitude about 13° South (*Albatross* Sta. 4675) and the Gulf of California (*Zaca* Stas. 139, 148). And being so large, and so conspicuous in color, it is not likely that it would have been overlooked in the collections that have been made around Japan, around the Hawaiian Islands, and in Philippine waters, did it occur there as frequently as it evidently does in the eastern side of the Pacific at comparable latitudes. In this respect it appears to differ from its Atlantic confrere, the distribution of which is general from the continental slope of America to northern Europe as well as seemingly more northerly, for its known range extends up to Davis Strait and the vicinity of Iceland (Kramp, 1919, Chart I, p. 13; 1920, p. 8), whereas it is not known farther south than the vicinity of Bermuda (Bigelow, 1938).

Aequoridae.

Zygocanna.

Zygocanna vagans Bigelow.

Text-fig. 14.

Zygocanna vagans, Bigelow, 1912, p. 255; 1919, p. 315, Pl. 42, Figs. 5-7; Pl. 43, Fig. 6.

Material: Sta. 225, 910-0 meters, 2 specimens, 40 and 33 mm. in diameter. Sta. 233, 910-0 meters, 2 specimens, 33 and 34 mm. in diameter.

These specimens all agree so closely with the type series of *Z. vagans* (Bigelow, 1912; 1919) that there is no doubt of their identity though the locality of capture is in the opposite side of the Pacific. They add, however, to our knowledge of the species by showing that the early branchings of the canals as indicated by the figures formed by the courses of the canal stripes on the aboral wall of the manubrium, not only are decidedly irregular (Text-fig. 14), but that the outermost branching of the canals is not as closely associated with the margin of the manubrium as it was in the original series, but may occasionally take place considerably centrifugal to the latter. Such for example is the case in one of the specimens from Sta. 233 (Text-fig. 14A). Furthermore, the sinus-like expansions of the gastric cavity along the lines of the groups of successively formed canals (Bigelow, 1919, p. 316), especially well developed in this specimen, show that no sharp line of demarcation can be drawn between manubrium and canal, in this highly variable species.

Associated, as I have pointed out, with this type of branching, the canals are in groups; the number of groups "varies according to the number of branchings which each main stem has undergone, and the number of canals varies from group to group" (Bigelow, 1919, p. 316). In the two members of the original series in which the four primary trunks could be identified, the number of canals from each that reached the ring canal varied between 5 and 12. In the present series again, in two specimens in which these primary trunks are identifiable, the number of canals to which each of the latter gives rise ranges between 4 and 7.

The smallest number of groups in which the canals are associated at the zone where they depart from the manubrium is 7 in the present series; the largest number is 10. The number of canals in a given group may be as small as 1 or as great as 8 even in different sectors of a given individual, the latter being the largest number yet observed.

The Philippine and *Zaca* series combined show that the numbers of canals and of tentacles tend to increase (though irregularly) with the growth of the medusa, as follows:

DIAMETER	CANALS	TENTACLES	RATIO TENTACLES TO CANALS
*29 mm.	33	42	1.3
31 mm.	27	32	1.2
32 mm.	22	33	1.5
34 mm.	26	30	1.2
*36 mm.	29	28	1.0
38 mm.	30	30	1.0
*39 mm.	38	54	1.4
*40 mm.	35	42	1.2
*43 mm.	46	46	1.0
*50 mm.	31	45	1.5
*68 mm.	45	50	1.1
*76 mm.	38	70	1.8

* Philippine specimens.

As the larger of the Philippine specimens had well-developed gonads, it is probable that the final number of canals is not likely to be much more than 45 in any specimen—perhaps not less than 35.
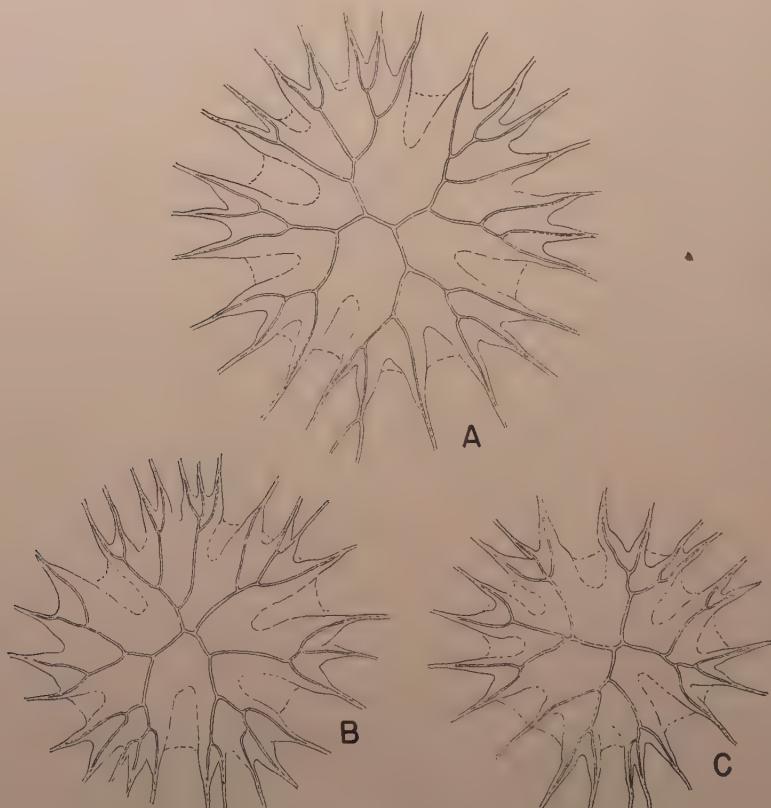
Text-fig. 14.

Zygocanna vagans Bigelow, central portions of discs of specimens from Stas. 225 (A) and 233 (B, C) to show canal stripes, camera drawings, about × 3.

In two, only, of the specimens so far examined, was the number of tentacles less than that of the canals; greater by at least 1 in all others. But comparison between size, number of canals and number of tentacles (ratios —, Table, p. 300) fails to suggest any general tendency for the disparity in number between the two classes of organs either to increase or to decrease with the growth of the medusa.

In the one member of the original (Philippine) series, on which a complete count of the marginal organs was made, there were from 4 to 11 rudimentary tentacular knobs between every two large tentacles. The fact that among the *Zaca* specimens the number was in one instance as small as 1 but frequently as large as 7, further emphasizes the wide variations in this respect that are to be expected in different sectors of the margin, in individual specimens.

The large size of the excretory papillae has already been commented upon in the original accounts of the species (Bigelow, 1912; 1919, Pl. 42, Fig. 6), which the *Zaca* series confirms.

In all of the present series, the gonads (immature) are confined to the outer ¼ or so of the radial canals. The condition, however, of the type specimen of 39 mm. (Bigelow, 1919, Pl. 43, Fig. 61) shows that they may already occupy more than ½ the lengths of the canals in medusae no larger—another evidence of variability of the species.

The subumbral gelatinous papillae, characteristic of the species, occupy the same locations in the *Zaca* series as in the original specimens, being confined to a row between every two adjacent canals and to the roof of the manubrium. The intercanalar rows consist in some cases of entirely separate conical prominences, in others of a sharp crest bearing such; the number along each series varies from 1-9, as against 5-10, with a maximum of 15 in the Philippine series. As in the latter the papillae are confined to the inner ⅔ or ¾ of the bell diameter. The chief difference in sculpture between the *Zaca* and Philippine specimens is that the latter had up to 16 rounded knobs within the limits of the manubrium, whereas the largest number of such knobs among the *Zaca* series was only three. But in view of variability in other characters this difference does not seem specifically significant.

The most interesting aspect of the present captures is evidence of the wide-ranging nature of *Z. vagans.* The facts not only that *vagans* has now been found in both sides of the Pacific, but that all representatives of *Zygocanna* recently taken are referable to it, raises the question whether the regular bifurcation of canals well distal to the margin of the manubrium described and figured by Haeckel (1879) for his *Zygocanna costata* from New Guinea correctly represented the normal state, or whether it actually represents Haeckel's idealization of the alcoholic specimen on which he based the species (and genus). Even in the latter case, however, there remains to separate *vagans* from *costata* the presence of the subumbral papillae in the former, contrasted with their absence (or at least with Haeckel's failure to mention them) in the latter; and of radial exumbral ridges in *costata* of which there is no trace in *vagans.* The *Zaca* series does not help toward a final decision as to whether Mayer (1910) was correct in uniting *costata* with Péron & Lesueur's (1809) old species *pleuronota.* However, the fact that the members of two successive series of *vagans* (taken so far apart in time and in space) lack any trace of peduncle, argues against Mayer's (1910, p. 339) suggestion that Haeckel's *Zygocannula* (with well-developed peduncle) is an advanced stage of *Zygocanna.*

TRACHOMEDUSAE.

Geryonidae.

Liriope.

Liriope tetraphylla Chamisso & Eysenhardt.

Geryonia tetraphylla, Chamisso & Eysenhardt, 1821, p. 357, Pl. 27, Fig. 2.

For recent discussions of this (apparently) monotypic genus, see Browne (1924); Thiel (1936); and Bigelow (1938).

Material: Sta. 227, 210-0 meters, one specimen about 12 mm. in diameter.

In this specimen the gonads are triangular, with their bases occupying most of the periphery of the bell, but not yet actually in contact, i.e., it is intermediate between the so-called "*rosacea*" and "*compacta*" stages already pictured from the Eastern Tropical Pacific (Bigelow, 1909, Pl. 3, Figs. 7, 8). *Liriope* with gonads of this type has so frequently been reported—especially from the high seas—that the present example adds nothing significant to our previous knowledge of this much-vexed genus.

Trachynemidae.

Colobonema.

Colobonema typicum Maas.

Homoeonema typicum, Maas, 1897, p. 22, Pl. 3, Figs. 1-3.

For recent discussion of the synonymy of this species, see Bigelow, 1938, p. 116.

Material: Sta. 219, 540-0 meters, 1 specimen, about 25 mm. high.

This specimen—in good enough condition for positive identification—adds nothing to previous knowledge of the morphology of this well-known bathypelagic medusa. Having been taken widespread in the Eastern Tropical Pacific, including the offing of Costa Rica and Gulf of California (Maas, 1907; Bigelow, 1909), it is somewhat astonishing that the *Zaca* collection yielded only a single example of it.

Halicreidae.

Halicreas.

Halicreas minimum Fewkes.

Halicreas minimum, Fewkes, 1882, p. 306.

Halicreas papillosum, Vanhöffen, 1902a, p. 68, Pl. 9, Figs. 7-8; Pl. 11, Fig. 30.

For reasons for the final relegation of *papillosum* to the synonymy of *minimum,* and for lists of the more important references, see Bigelow, 1938, pp. 121, 122.

Material: Stas. 165, 210, 225, 227, 228, 230, 234, 15 specimens, all in hauls from 910-0 meters.

The condition of the specimens is so poor that they add nothing to previous accounts of this well-known species. All, however, show the characteristic exumbral papillae, and it is chiefly on these that their identification rests.

Having already been recorded at many stations in the eastern side of

the Tropical Pacific (Bigelow, 1909), *H. minimum* was to be expected in the region explored by the *Zaca*. It is, in fact, now known to be one of the most generally distributed and frequently occurring of bathypelagic medusae in the open oceans, in low and mid-latitudes, as discussed elsewhere (Thiel, 1936, p. 72; Bigelow, 1938, p. 122).

NARCOMEDUSAE.

Solmaridae.

The majority of recent authors have concurred in uniting in this one family all Narcomedusae that lack gastric pockets. Ranson (1936), on the other hand, has revived the old family designation Peganthidae, for such of them as have the gonads localized in interradial diverticulae of the gastric wall, as opposed to those in which they extend, ring-like, right around the margin of the stomach. To use the conformation of the gonads as a basis for family separation among the Narcomedusae that lack gastric pockets would, however, run counter to another set of alternative characters, namely, the presence or absence (at least in one generation) of a canal system and of otoporpae. Our knowledge of the existence of solmarids with canals and otoporpae, but with a simple annular gonad, rests not only on Haeckel's (1879; 1881) account and figures (from life) of his *Polycolpa forskalii* from the Red Sea, but equally on Browne's (1916) discovery of a second unnamed Narcomedusa of this type from the Indian Ocean. In fact, the *Cunina prolifera* of Gegenbaur (for synonymy, see Mayer, 1910, p. 480), which also has an annular gonad and otoporpae, appears also to belong to this group, for none of the published illustrations of this species show any gastric pockets. Stschelkanowzew (1906, p. 483) indeed states definitely that it has none, but that its stomach, is perfectly round in life, though taking an angular outline when preserved as is shown by Mayer (1910, p. 471, Fig. 319A). *C. prolifera* should then be removed from the Aeginidae to the Solmaridae (and referred to *Polycolpa* if that genus be recognized, see below) as Stschelkanowzew suggested, though he did not actually go so far as to make this alteration.

The question is further complicated by the fact that the canals and otoporpae, so conspicuous in the primary generation of *Pegantha* are lacking in the second parasitic generation that develops within that genus, at least up to the most advanced stage to which development has been followed (Bigelow, 1909, p. 93), so that morphological diagnosis that applies to one generation would not to the other. It therefore seems wiser to maintain the family Solmaridae as widely inclusive for the time being; admitting, however, that this may be only a temporary stand, in the slow and spasmodic growth of our knowledge of the Narcomedusae.

Within the Solmaridae, as thus conceived, three groups of species appear to be rather definitely definable: A, with simple annular gonad, lacking canals and otoporpae; B, with simple annular gonad, with canals, and with otoporpae; and C, with interradial sexual sacs (whether or not combined with an annular gonad), with canals, and with otoporpae. The first of these groupings is now generally referred to *Solmaris;* the second is the genus *Polycolpa* of Haeckel (made by Mayer, 1910, a synonym of *Solmaris*); it is with the third that we are concerned here.

For the members of this last group, Haeckel (1879) revived the old genera *Pegasia* of Péron & Lesueur (1809) and *Polyxenia* of Eschscholtz (1829), as well as proposing his new genus *Pegantha*. And it is certain that in any final revision these two old generic names must be taken into account, for we have as good grounds for identifying them with the medusae in question, as in most of the cases in which final disposition of the early medusan names has been made.

Actually, it seems that the earliest description of a typical peganthid was neither of *Pegasia* nor of *Polyxenia,* but of the *Medusa mollicina* of Forskål (1775). This Péron & Lesueur (1809) later referred to their genus *Faveola,* but incorrectly since the first mentioned member (hence type species) of the latter—the *Medusa pilearis* of Linnaeus (1766)—was an Anthomedusa and probably what is now known as *Leuckartiara.* The next description of what was probably a peganthid (though no indication was given as to presence or absence of a canal system nor of otoporpae) was by Eschscholtz (1829) as *Polyxenia cyanostylis.* Meantime, however, Péron & Lesueur (1809) had published a brief notice of *Pegasia dodecagona.* And while their account and the subsequent illustration by Blainville (1834) are unrecognizable if taken *per se,* Haeckel (1879, p. 331) from personal examination of one of Péron & Lesueur's original specimens, placed it in his family Peganthidae— thereby at least implying a lack of gastric pockets, but presence of a peripheral canal system—described its gonads and even counted the otocysts. Our choice lies, then, between ignoring Haeckel's diagnosis as Vanhöffen (1908) has done (partly on the ground that it was not accompanied by an illustration) or accepting *Pegasia* as the oldest generic name applicable to the group in question. And the latter alternative appears much the more likely to conduce toward stability of nomenclature. In other words, we can credit Haeckel with doing for *Pegasia* what Chun (1897) did for *Abylopsis tetragona* Otto, among siphonophores, i.e., with establishing the status of an old species from reexamination of a type specimen, the original account of which had been wholly inadequate, or even erroneous.

Accepting the validity of the name *Pegasia,* we have still to decide whether all known members of the group to which it belongs (i.e., solmarids with otoporpae, with canals, and with genital diverticulae) should be referred to it, or whether they represent more than one genus. Generic grouping based on the number of tentacles, suggested by Vanhöffen (1908; 1911; 1912) having been proven untenable in this case, decision rests on what value in classification is to be assigned to the conformation of the gonads. And while Vanhöffen (1908), Mayer (1910), and subsequent authors generally have been of the opinion that this is not of more than specific import in the group in question, it seems wiser to reserve judgment, until the time (if ever), when some student has the opportunity to examine actual specimens in which an annular gonad is combined with interradial sexual sacs—i.e., referable either to *Polyxenia,* or to *Pegasia* as redefined by Haeckel.

Accordingly, the generic name *Pegantha* is retained here (as earlier by me) with the Haeckelian diagnosis, i.e., for Solmaridae in which the sexual products are confined to interradial outpocketings from the gastric margin, irrespective of the number of tentacles. Should it prove, in the future, that the gonads must be discarded here, as a generic character, the name *Pegasia* (or if not *Pegasia,* then *Polyxenia*) will have priority.

Pegantha.

Anatomically, *Pegantha* is one of the best known of narcomedusan genera. Our knowledge, however, of specific relationships within the genus has not significantly advanced since 1918, when I briefly outlined the existing status in this respect (Bigelow, 1918, p. 395). Nor does the present series contribute toward a final solution, for one of the two specimens of *Pegantha* that it contains, belongs to a species that has already been fully described, while the other is not in good enough condition for positive identification.

### **Pegantha clara** R. P. Bigelow.

Text-figs. 15, 16.

Pegantha clara, R. P. Bigelow, 1909, p. 80.
Pegantha smaragdina, H. B. Bigelow, 1909, p. 90, Pl. 14, Figs. 1, 2; Pl. 19, Figs. 1-9, Pls. 22-26.

To the synonymy and list of references given earlier by me (Bigelow, 1938, p. 134), add *P. smaragdina*, Hanitzsch, 1911, p. 225.

Material: Sta. 230, 910-0 meters, 1 specimen about 55 mm. in diameter with 25 tentacles, in fair condition.

In its low disc without exumbral sculpture, and simple gonads (hemispherical when relaxed but more or less constricted when contracted), the *Zaca* specimen agrees very well with the earlier accounts by R. P. Bigelow of the Atlantic *P. clara* and by me almost simultaneously of *P. smaragdina* from the Eastern Tropical Pacific. The number of tentacles (25, 2 much smaller than the others) also falls well within the recorded limits (19-34). And this also applies to the number of otocysts, of which there are five (4 of them with well developed otoporpae, but 1 lacking such an organ) in the only sector in which they can be counted, and three, with otoporpae, close together in the next, so localized as to suggest a total of 6-8. In short, it corroborates the conclusion arrived at first by Vanhöffen (1912a) and subsequently by me (1938) that *smaragdina* cannot be distinguished specifically from *clara*. In my original (1909) discussion of the former it was suggested
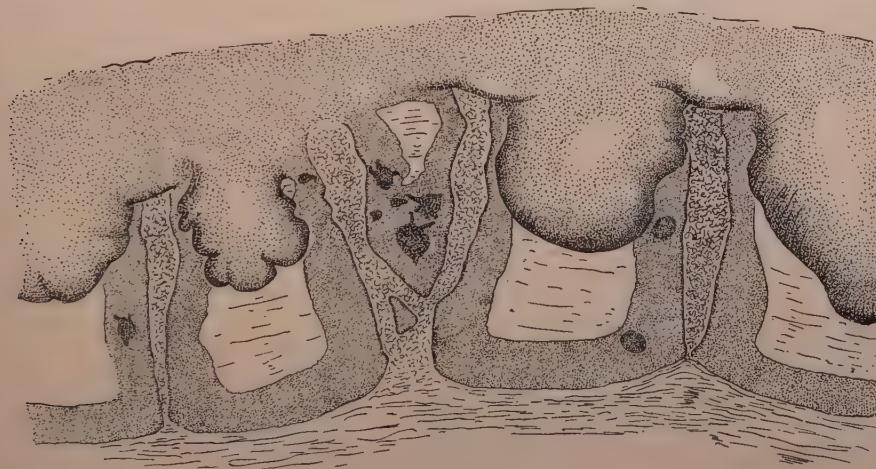

Text-fig. 15.
Pegantha clara R. P. Bigelow, aboral view of gonads and canal system with polyp larvae, camera drawing, about × 7.

that the ova (difficult of detection because of their small size) may develop irregularly over the wall of the manubrium, as is the case according to Stschelkanowzew (1906) in *Cunina proboscidea*, i.e., that it may be the males alone that develop discrete gonads. In fact, ova have not been definitely identified as yet, in any *Pegantha*, so far as I am aware. And surface views of the sexual sacs of the *Zaca* specimen are at least compatible with this suggestion, no ova being visible, even after staining, but only very closely crowded masses of minute cells, suggesting stages in spermatogenesis.

Anatomically, the specimen is interesting as showing individual tendency toward abnormality, for the otoporpae vary greatly in length, while one of the peronii is abnormally broad distally, and bifid proximally, with a small tentacle associated with the one branch but none with the other, the two branches being separated by a canal, but one so much shorter than the others that it fails to reach the margin of the bell (Text-fig. 15).
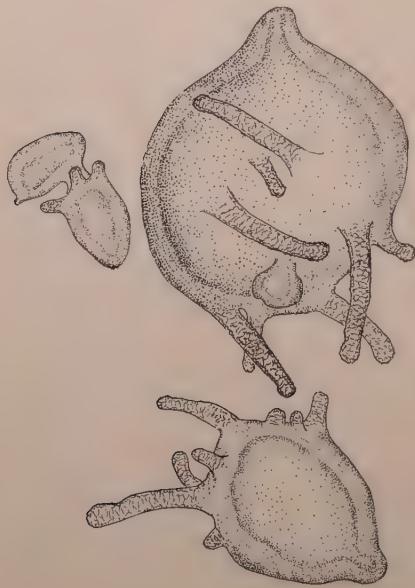
Text-fig. 16.
Pegantha clara R. P. Bigelow, enlarged view of three of the larvae shown in Fig. 15, camera drawing, $\times$ 42.

The most interesting feature of the *Zaca* specimen is that its canal system contains several polyp-larvae (Text-fig. 16) with much younger (cleavage) stages in the mesoglea, agreeing very closely with those described by me (1909) for one of the two *Albatross* specimens from the Eastern Pacific. These have not been found in any Atlantic example of the species that has yet been examined. It is worth repeating, however, in this connection, that small medusae, resembling the 2nd generation of *P. clara*, have often been observed in the gastrovascular cavity of the Mediterranean Narcomedusa usually referred to in literature as *Cunina prolifera* Gegenbaur, but which is not a *Cunina* but a peganthid (p. 303). Unfortunately, the histological condition of the *Zaca* specimen was not good enough to add anything of moment to my earlier account of the developmental stages. Their presence, however, in this second example shows that it is characteristic of the earliest stages to be confined to the mesoglea of the exumbrella of the parent, overlying—in this case—the part of the vascular system that is

occupied by the older larvae. It is also interesting that the latter, like those earlier described, show stages in budding at the aboral side.

Were it alone in *P. clara* that this type of development had been observed, it might reasonably be questioned whether the resultant small medusae do indeed belong to the developmental cycle of the large medusae within which they occur, for we lack actual factual knowledge of the source of the infesting larvae. Since, however, Stschelkanowzew (1906) was able to show that similar larvae, found parasitic within *Cunina proboscidea*, develop from the fertilized ova of that same species, we may assume that the same is true of *Pegantha*.

In the case of *Cunina*, it appears, indeed, (from Stschelkanowzew's studies), that the larvae are the offspring of the same individuals within which they develop. Since, however, the larvae have now been found in a specimen of *P. clara* lacking any trace of gonads, and in a second in which the latter are well developed, it seems that in this species any large individual (whether or not mature) may become infested if in the vicinity of others that are actually setting free their eggs and sperm in the water. And this seems the more likely, from the fact that in this particular Narcomedusa (in contrast to *Cunina proboscidea*) the earliest developmental stages are to be found in the exumbral mesoglea. In other words, there is no necessity for assuming that the larvae found within a given individual are its own offspring. But this whole matter necessarily remains open, until the fertilization of the egg and its actual penetration have been traced.

According to Hanitzsch' (1911) interpretation, based on Stschelkanowzew's (1906) cytological studies of the oogenesis of *Cunina*, the mitotically dividing amoeboid cells of *P. clara* (Bigelow, 1909, Pl. 22, Figs. 8, 9) represent the product either of the last maturation or of the first cleavage division, and those amitotically dividing (which later act as the nurse cells for the embryo) are oocytes that have lost their character as sex cells.

A serious gap still remains in our knowledge of the developmental cycle of *P. clara*, between the medusae of generation II (i.e., the small parasitic) which are set free at what may be termed the *"Solmissus"* stage when some 3 mm. in diameter, and those of generation I, within which they have been found. In the case of *Cunina proboscidea* Stschelkanowzew (1906) concluded that an asexual polyp generation intervenes, both because the direct development of the medusae of generation II into those of generation I seems precluded by differences in structure, and because he believed he could identify as the young of *C. proboscidea* (by the shape of the otoporpae) the medusae set free from one of the two species of narcomedusan stolons that are often found parasitic within the gastric cavity of *Geryonia*.[6] Metschnikoff (1874, p. 34) had in fact made this same suggestion, long before. These stolons, as is well known, are the growth products of ciliated larvae, which Woltereck (1905, Figs. 12-14) traced back to early cleavage stages in the mesogloea of *Geryonia*. But the actual process by which the latter is parasitized by them has not yet been observed; we have only Stschelkanowzew's suggestion, accepted by Hanitzsch (1921, p. 225), that the small medusae of *C. proboscidea* of generation II are eaten by the *Geryonia* and that their eggs and sperm come together within the cavities of the latter.[7]

Perhaps a stolon-generation intervenes, in *Pegantha clara* also, between the medusae of generations I and II. But it is equally possible that in this species the large medusae of generation I develop directly from the fertilized eggs of the small "solmarid" medusae of generation II.

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[6] These are the stolons usually referred to as *"Cunina parasitica* Metschnikoff."

[7] The development of *Cunina proboscidea* has been discussed not only by Metschnikoff (1886) and Stschelkanowzew (1906), but subsequently in great detail by Hanitzsch (1911-1921).

? *Pegantha martagon* Haeckel.

Pegantha martagon, Haeckel, 1879, p. 332; Bigelow, 1909, p. 83, Pl. 18, Figs. 1-8; Mayer, 1910, p. 443.

Pegantha simplex, Bigelow, 1904, p. 260, Pl. 5, Figs. 19, 20.

Material: Sta. 234, 1 fragmentary specimen, about 18 mm. in diameter, with 12 tentacles.

The condition of this specimen is not good enough for positive identification, further than that absence of gastric pouches and presence of a well-developed canal system prove it a *Pegantha*. It is tentatively referred to *P. martagon* for the following reasons: 1, the bell is high-rounded, but above the level of the tentacular insertions, shows no trace of the exumbral sculpture that is so prominent in *P. triloba*; 2, the gonads, while showing a certain amount of irregular wrinkling and lobing are not definitely subdivided. The margin is so much damaged as to prevent counting the otocysts; it is unfortunate, in particular that the otoporpae have been entirely destroyed, because the structure of these is one of the respects in which *P. martagon* differs the most sharply from *P. triloba* (Bigelow, 1909).

Solmissus.

Ranson (1936, p. 206) in his recent discussion of *Solmissus*, is of the opinion that *S. incisa* Fewkes is a "forme géante" of *S. albescens* Gegenbaur, but that the Indo-Pacific *S. marshalli* Agassiz & Mayer is a well defined species rather than a variety of *albescens* as I (1909; 1919) formerly suggested.

Solmissus marshalli Agassiz & Mayer.

Solmissus marshalli, Agassiz & Mayer, 1902, p. 151, Pl. 5, Figs. 23-25; Bigelow, 1909, p. 64, Pl. 16, Figs. 5-6, Pl. 21, Figs. 4, 6-8; 1919, p. 329; 1938, p. 129; Mayer, 1910, p. 484; Thiel, 1936, p. 68; Ranson, 1936, p. 208.

Solmissus punctatus, Mayer, 1906, p. 1133.

Solmissus flavescens, Vanhöffen, 1908, p. 56, Pl. 2, Figs. 9-10, Pl. 3, Figs. 20-22.

(*Non Solmissus flavescens* Kölliker).

Material: Sta. 233, 2 specimens respectively about 34 mm. and 52 mm. in diameter.

Tentative identification of these two specimens rests on the fact that, in each case, traces of the outlines of gastric pockets in the radii of the tentacular roots are still to be seen, combined with a flat-lenticular type of bell characteristic of *Solmissus* of the *albescens-marshalli* group. Failing any trace of the otocysts, and lacking knowledge of the precise contour of the gastric pockets, they are referred to *marshalli* on geographical grounds, because *albescens*—the common *Solmissus* of the Mediterranean—has not yet been taken in the Pacific.

Unfortunately, the condition of the specimens is so poor that the number of tentacles cannot be stated exactly, further than that in one case 8 large tentacular roots were detected and in the other nine. But these numbers are so much smaller than is usual in full-grown *marshalli* (usually 12-16) as to suggest that there had been more tentacles in life, but that some had been obliterated.

It has long been known that *marshalli* (or the *marshalli* variant of *albescens*) is widespread in the tropical and subtropical belts of the Pacific, Indian and Atlantic oceans, while Ranson (1936) has recently reported it from the Mediterranean.

Aeginidae.

Aeginura.

Recent authors agree that all representatives of *Aeginura* that have come to hand, subsequent to Haeckel's (1879) original account of the genus, are referable to the single species *grimaldii* Maas (1904)—of which *weberi* Maas (1905) and *grimaldii* var. *mundi, guinensis* and *obscura* of Vanhöffen (1908) are synonyms. The relationship, however, of *grimaldii* to the medusa (*myosura*) on which Haeckel founded the genus, and to Haeckel's *Cunoctona nausithoe* and *C. lanzerotae* (which are described as having otoporpae) is still in doubt; may, in fact, always remain so. Having recently (1938, p. 132) discussed this question, there is no need for me to revive it here.

Recent students of Narcomedusae have been unanimously of the opinion that the chief generic character of *Aeginura* is the constant presence of 8 tentacles and 16 gastric pockets; and it has seemed at least probable that the presence of small secondary tentacles on the margin is equally diagnostic, for while Haeckel (1879; 1881) neither mentioned nor pictured any such for *myosura*, their apparent absence in the latter may well have been due to the mutilated state of the unique (alcoholic) specimen. But it is now necessary to redefine the genus, or to institute a new one, for the *Zaca* collection contains a specimen that agrees with *Aeginura* in the arrangement of the gastric pockets in relation to the large primary tentacles, and in the presence of small secondary tentacles on the bell-margin between the peronii, but in which the number of tentacles, and of primary gastric pockets is eleven, instead of eight. Decision in this case obviously depends on the relative phylogenetic weight to be attached to metameral number, as compared with the presence of the secondary tentacles. About this opinions may differ. Since, however, the number of primary tentacles in the Narcomedusae may either be strictly determinate, as for instance in *Solmundella* and *Cunoctantha*, or highly variable as in some species of *Pegantha* and *Cunina*, whereas the presence of secondary tentacles is a feature peculiar (so far as yet known) to *Aeginura*, it seems to me wisest to use the latter as the primary generic character for that genus, expanding the latter to include species with more than 8 tentacles.

### *Aeginura beebei* sp. nov.

(Text-figs. 17-20).

Material: Sta. 227, 910-0 meters, 1 specimen, about 100 mm. in diameter in fair condition.

This specimen (Text-figs. 17-20) is perhaps the most interesting find among the *Zaca* medusae, for while in general appearance it resembles *Solmissus*, critical examination shows that it actually agrees, in all significant anatomical characters, with the bathypelagic medusa *Aeginura grimaldii*. It differs, however, from the latter in the fact that it has (as just stated) a larger number of antimeres (11) than has ever been recorded for *Ae. grimaldii* in which the normal 8 has never been exceeded—though Ranson (1936, p. 210) records one specimen with as few as five.

Most at least of the secondary tentacles are intact, and certainly a majority of the otocysts: the numbers of marginal organs counted per antimere, being as follows:—

Tentacles	3	1	2	2	1	1	3	1	2	1	2
Otocysts	5	2	4	1	2	3	6	3	3	2	2

Thus, there is no evidence that the number of secondary tentacles ever exceeds 3 per sector, while in at least 5 of the sectors, the condition of the
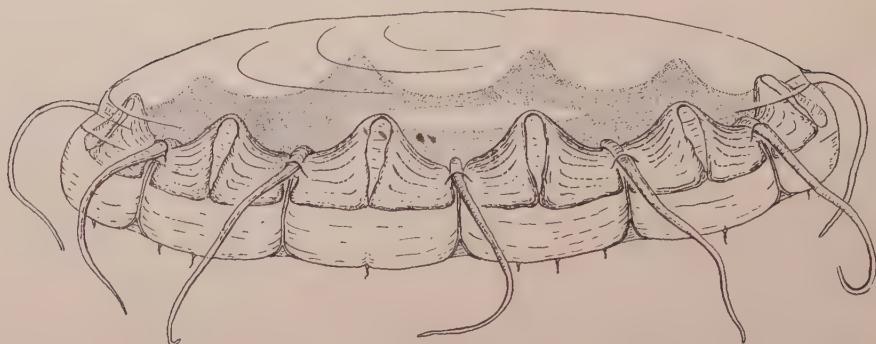
Text-fig. 17.
Aeginura beebei, sp. nov., lateral-oblique view of type specimen, slightly more than natural size.
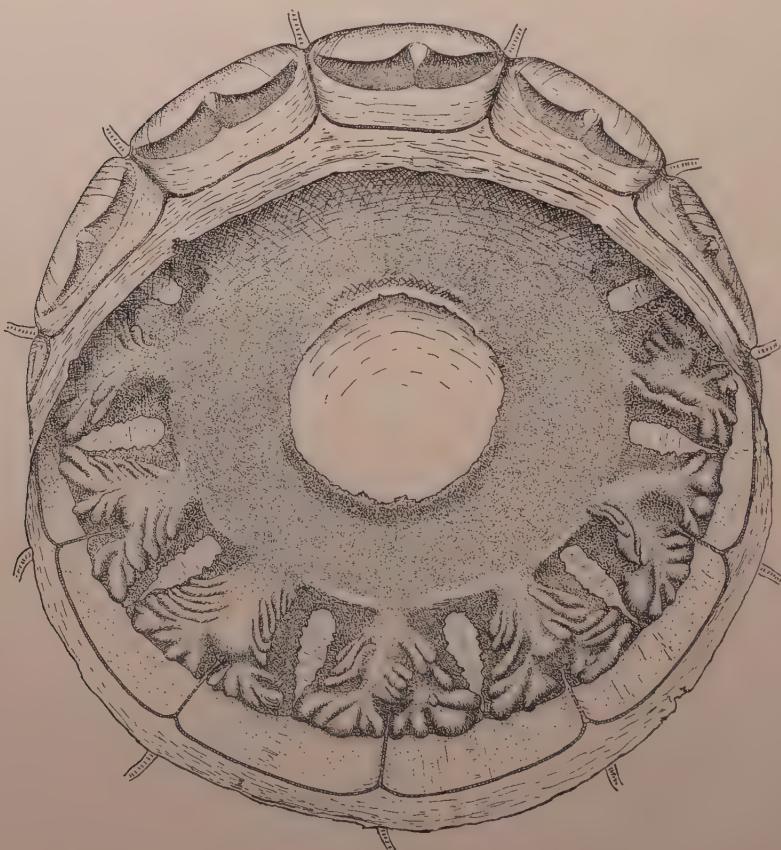
Text fig. 18.
Aeginura beebei, sp. nov., oral-oblique view of type specimen, slightly more than natural size.

margin was so good as to allow positive assertion that there was only one secondary tentacle. In *grimaldii* (or its synonyms), the recorded number per marginal sector ranges from 2 to 5, the total thus being about the same as in the new species.

Structurally, the secondary tentacles of *beebei* differ from the primary tentacles in the fact that they lack entodermal roots, while their bases are much swollen (Text-fig. 19), hence there is no reason to suppose that the former ever develop into the latter. In detail (i.e., in the core of chordate entodermal cells and in the slender filament) they agree very closely with Vanhöffen's (1908, Pl. 9, Fig. 28) illustration of the corresponding structures in his "*Cunoctana obscura*," which was undoubtedly identical with *Ae. grimaldii*.

A secondary tentacle is flanked, in so many cases, by an otocyst on either hand (Text-fig. 19) that this appears to be the basic state. However, the presence of three otocysts each, in two of the marginal sectors but of only one secondary tentacle, proves that neither the numerical relationship between the two, nor their relative locations on the margin, are determinate. A similar variation in number and spacing of otocysts has already been recorded for *grimaldii* (Vanhöffen, 1908). On the average, the number of otocysts per sector (there being fewer secondary tentacles) is somewhat smaller in the new species than in *grimaldii*, but the difference may not be great enough to be of diagnostic significance. In their structure (Text-fig. 20) the otocysts are of the usual aeginid type.
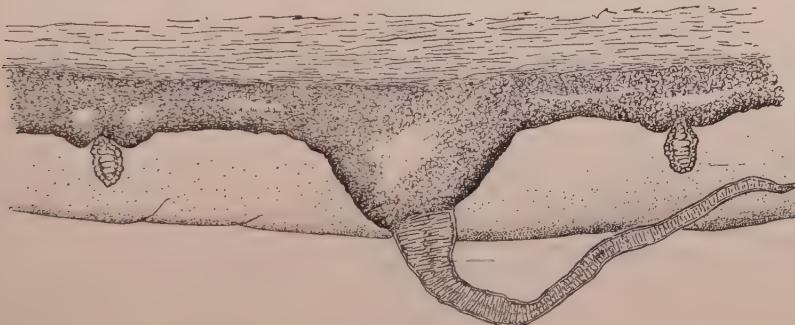

Text-fig. 19.

Aeginura beebei, sp. nov., aboral view of portion of margin, with secondary tentacle and otocyst, camera drawing, × 66.

The specimen corroborates previous observations to the effect that in *Aeginura* the interradial notches that indent the margin of the gastric cavity are much deeper than the perradial, such for example was the case in the specimen from the East Indies figured by Maas (1905) as *Ae. weberi*; in the *Albatross* specimens from the Eastern Tropical Pacific and Northwestern Pacific (Bigelow, 1909, p. 80; 1913, p. 62), and likewise in Maas' (1904, Pl. 3, Fig. 20) original figure of *Ae. grimaldii*, in which the interradial notches are pictured as about twice as deep as the perradial. Haeckel (1879; 1881), on the other hand, pictures the reverse for *Ae. myosura*, this being one of the reasons for doubting whether this species has been seen subsequently. In the *Zaca* specimen of *Ae. beebei*, the interradial notches are about 16-17 mm. deep, but the perradial only 4-5 mm. The gastric pockets themselves are rhomboid in outline (Text-figs. 18, 20), broader distally than proximally, with the outer angles of adjacent pockets very close together. Surface views, in fact, suggest that they may even be confluent, which would be unique among Narcomedusae. But the condition

of the specimen is not good enough for positive determination of this point, though it was easy to trace the general outlines of the pockets by surface examination, verified by the injection of air. A specific character, which, while minor in itself, is again unique, so far as known among aeginids, is that the interradial margins of the pockets are jagged or lobate (Text-fig. 20). Neither surface view nor injection yielded any evidence of the presence of a peripheral canal system, in which *beebei* agrees with *grimaldii*. The central part of the stomach has been largely torn away—the remnants, how-ever, suggest a simple circular mouth (Text-fig. 18).
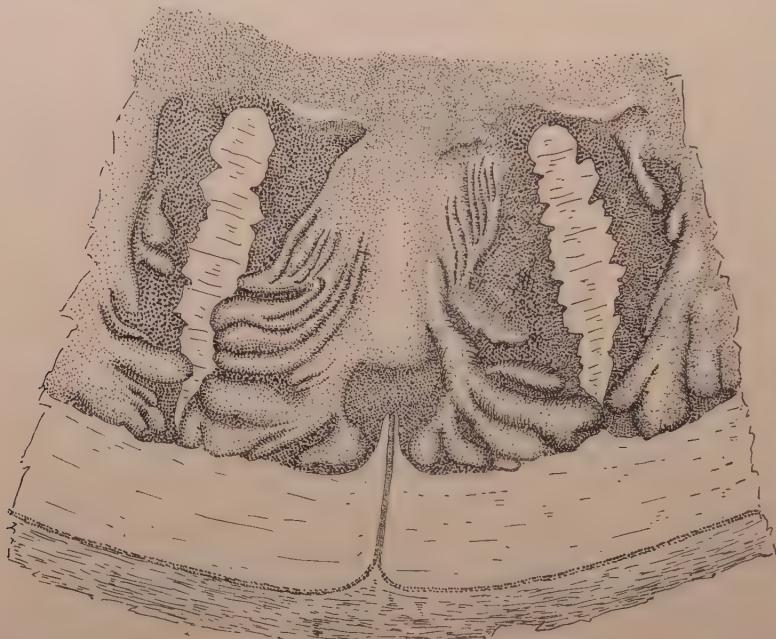
Text-fig. 20.
Aeginura beebei, sp. nov., oral view of gastric pockets, about × 3.

The gastric wall, at the interradial sides of the pockets, is thrown into a series of folds directed obliquely distal (Text-figs. 18, 20), no doubt the sites of the sexual products. Surface views suggest that the specimen is a male—at least no individual eggs are to be seen. And to judge from analogy with *Ae. grimaldii*, the latter might be expected to be so large as to be conspicuous.

A striking feature of the specimen is that the subumbrella is deeply indented with triangular depressions along the lines of the interradial septa that separate the gastric pockets, and also with furrows along the perradial septa. Thus, were the gastric wall to be stripped off, the subumbral zone occupied by the pockets would appear as alternate triangular prominences and depressions, the former with their bases directed distally, and shallowly notched in the perradii, the latter with their bases directed toward the center of the bell. The bell is low discoid in form, about ⅙ as high (18 mm.) as broad, with very shallow bell cavity, i.e., hardly deeper than the breadth of the marginal groove. There is no exumbral sculpture, other than the shallow furrows along the lines of the peronii that are a common feature among Narcomedusae.

The gastric wall in the preserved state (formalin) is pale purplish. Otherwise the specimen is colorless.

The features in which *Ae. beebei* most sharply differ from *Ae. grimaldii* are 1, larger (and probably indeterminate) metameral number; 2, presence of prominent subumbral sculpture; 3, much larger size at maturity; 4, entire lack of the distinctive bathypelagic pigmentation.

Obviously, the one capture, having been made in an open net, yields no information as to the normal bathymetric occurrence of the species, but the fact that it is so faintly pigmented suggests that it is a creature of the upper waters.

Aeginura grimaldii Maas.

Aeginura grimaldii, Maas, 1904, p. 38, Pl. 3, Figs. 19-28.

See Bigelow, 1938, p. 132, for recent discussion of *Aeginura* with the reasons why it seems wiser to retain Maas' species *grimaldii* as distinct rather than to unite it with Haeckel's (1879) old species *myosura, nausithoe,* and *lanzerotae* as Thiel (1936) has done in his historical survey.

Material: Sta. 227, 910-0 meters, 1 fragmentary specimen about 23 mm. in diameter.

Sta. 228, 910-0 meters, fragments.

Aeginura grimaldii is represented so regularly in collections from deep water that it must be one of the most generally and frequently distributed of bathypelagic medusae. As a rule, however, the specimens taken have been badly damaged amid the mass of other plankton. And the present examples are no exception, for the one (Sta. 228) is made recognizable only by the pigmentation in combination with the fact that a few of the conspicuous white ova are still intact, while the other—in a somewhat better state— is so battered that only one of the secondary tentacles is still to be seen, and none of the otocysts. Hence they add nothing to previous accounts based on better material.

Aegina.

Aegina citrea Eschscholtz.

Aegina citrea, Eschscholtz, 1829, p. 113, Pl. 10, Fig. 3.

See Bigelow, 1938, p. 130, for the most recent discussion of this genus; Mayer, 1910, pp. 451-454, and Thiel, 1936, p. 73 ("*Ae. rosea*"), for lists of references to the various named representatives of *Aegina,* all of which probably refer to the one species, *citrea.*

Material: Sta. 210, 910-0 meters, 1 specimen about 17 mm. in diameter.

Sta. 230, 910-0 meters, 1 specimen about 22 mm. in diameter.

Both of these specimens are of the so-called "*rosea*" type, i.e., with the margins of the 8 adradial gastric pockets entire. A point still to be determined is the range of variation in number of otoliths that is normal for the species. In this connection it is interesting that in one quadrant of the specimen from Sta. 230 there are 14 of these organs—this probably being the complete number, since they are evenly spaced. This is somewhat fewer than recorded by Vanhöffen (1908a), namely, 16-20 per quadrant, but a larger number than reported by most other authors.

Beyond this, the present series calls for no special comment, for *Ae. citrea* has repeatedly been described and figured from specimens in better condition.

SCYPHOMEDUSAE.

CORONATA.

Periphyllidae.

Periphylla.

Periphylla hyacinthina Steenstrup.

Periphylla hyacinthina, Steenstrup, 1837.

For synonymy and recent discussion see especially Mayer (1910, p. 544, "*P. hyacinthina*"), p. 546 ("*P. hyacinthina* forma *regina*"); Broch, 1913, p. 4; Stiasny, 1934, p. 342; and Bigelow, 1938, p. 155.

Material: Stas. 148, 158, 210, 225, 227, 228, 230, 233, 234; a total of 22 specimens from about 15 to about 150 mm. in diameter at the level of the coronal furrow, all in hauls from 910-0 meters.

It now seems certain that all known representatives of the genus *Periphylla* actually belong to a single species. It also seems established that in general the "*dodecabostrycha*" form (small; low-rounded bell; transparent peripheral zone), the "*hyacinthina*" form (peripheral zone pigmented, bell usually high-arched, pointed), and the "*regina*" form (dense pigmentation, low-domed bell) represent successive stages in growth. But it is still an open question whether every *Periphylla* (if it survives) normally passes from the "*hyacinthina*" stage into the "*regina*" stage, or in what degree this basic succession may be confused by individual variation as to development of pigment, and as to bell-shape in relation to size. The fact that the largest specimens among the considerable series collected by Dr. Beebe near Bermuda during the years 1929 and 1930 (Bigelow, 1938, p. 156) were less than 60 mm. in diameter (at level of coronal furrow) but still referable to the "*hyacinthina*" stage also suggests that certain populations may fail to develop beyond this, before they die. It is in fact likely that this may apply to a considerable percentage of the individuals among other populations, some of whose members do finally attain the "*regina*" stage. Stiasny (1934, p. 361) has pointed out that the latter (i.e., the largest adults) have as a rule been taken well out from any coast, whereas the distribution of the "*dodecabostrycha*" stage makes it likely that "the small stages of Periphylla have their origin on the continental slope or near the coast - - - - and that they are driven into the open sea and sink slowly to greater depths." But such a tendency toward offshore dispersal can hardly explain the absence (or at least great scarcity) of large specimens near Bermuda, for the collection was made at a station as typically oceanic as one could ask; as much so certainly as the Indo-Pacific localities, where the "*regina*" stage has been taken, namely the Galápagos-Cocos Island region, the *Zaca* stations, and the Gulf of Aden (Maas, 1897; Bigelow, 1909; 1928; Vanhöffen, 1902). To what extent such variations may be correlated with seasonal differences between generations in a given region is equally a question for the future.

The most interesting feature of the present series is that it contains two large specimens, respectively about 85 mm. and about 110 mm. in diameter at the level of the coronal furrow, that agree very closely in low-rounded bell, rectangular pedalia, stout tentacular bases and dense pigmentation[8], with the specimens of the "*regina*" stage recently recorded by Stiasny (1934). The fact that in the 85 mm. specimen (alcoholic) the pedalia are rather sharply marked off from the coronal zone but that in the 110 mm. example (in formalin) and also in the largest of all (about 150 mm., fragmentary) they merge insensibly into the latter just as in the *Discovery* examples, is additional evidence (if any were needed) that characters that have been used as specific among medusae may actually represent nothing more than the results of different methods of preservation.

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[8] Except where obviously rubbed off.

Atollidae.

Atolla.

Atolla wyvillei Haeckel.

Atolla wyvillei, Haeckel, 1880, p. 488; 1881, p. 113, Pl. 29, Figs. 1-9.

See Broch (1913, p. 13), Browne (1916, p. 203), Bigelow (1928, p. 505; 1938, p. 160), and Stiasny (1934, p. 365), for early synonymy, and Bigelow (1938, p. 162), for a recent summary of distribution.

Material: Stas. 210, 219, 225, 228, 230, 233, 234; 24 specimens, all in hauls from 910-0 meters. The series range in diameter from about 11 mm. to about 95 mm.

This series—all are in more or less fragmentary condition—adds little except by way of confirmation to what is already known of this cosmopolitan bathypelagic medusa. Neither do the records extend the known range, for *A. wyvillei* had already been recorded widespread in the eastern side of the Pacific, not only in low latitudes, but far to the north as well as far to the south of the areas crossed by the *Zaca.*

Among such of the *Zaca* series as are in good enough condition to show the state of the disc, it is more or less furrowed in eleven, but smooth in four, a considerably smaller proportion of smooth-disced than reported near Bermuda (Bigelow, 1938, p. 161), but almost precisely the same proportions as found by Kramp (1924) in the Mediterranean. However, various collections, combined, from the Antarctic (Stiasny, 1934), Mediterranean (Kramp, 1924), and from various localities in the North Atlantic (Broch, 1913; Bigelow, 1928; 1938) have contained about as many of one type as the other (230 smooth, 233 notched).

Unfortunately, the smallest specimens were not in good enough condition to show whether the gonads had appeared, as they commonly do by the time a diameter of 10 mm. is reached. The presence, however, of one specimen of 25 mm., in good condition but showing no trace of gonads, proves that some *Atollas* may reach a considerable size before the sexual organs appear; a retarded development for which no explanation is as yet forthcoming.

DISCOPHORA.

Pelagidae.

Pelagia.

Pelagia noctiluca Forskål

Medusa noctiluca, Forskål, 1775, p. 109.
For summary of synonymy, see Bigelow, 1938, p. 164.

Material: Stas. 219, 227, 230, 233, 234, and Gorgona Island, 34 specimens, about 20 mm. to about 75 mm. in diameter, in hauls at the surface and from 910-0 meters.

All of the smaller specimens are in very fragmentary condition. The two largest, however, (about 65 mm. and about 75 mm. in diameter) are well preserved.

These specimens of this cosmopolitan inhabitant of warm seas all fall well within the known limits of variation of *P. noctiluca.* In fact, it has yet to be proven that this does not apply to every specimen of *Pelagia* from whatever source, that has yet been critically examined. Hence, the general agreement, by recent authors (see especially Kramp, 1924; Stiasny, 1934; Bigelow, 1928; 1938) that the genus, as now known, is monotypic, and that

some designation other than "species" must be invoked to designate the numerous variations as to form and distribution of exumbral nematocyst knobs, on which specific names have been based.

Stomolophidae.

Stomolophus.

Stomolophus illustrates the situation—not uncommon among medusae—where the Linnaean system of classification cannot adequately represent the existing facts, for while the named representatives of the genus differ widely, they are connected by so continuous a series of intermediates in all characters supposedly diagnostic that it appears impossible to define distinct species in the ordinary sense. And, correspondingly, the history of the genus has been one of alternate multiplication and reduction. Thus, Mayer (1910) reduced the five named forms to one species *meleagris* L. Agassiz and one variety of the latter (*fritillaria* Haeckel), while I (Bigelow, 1914) concluded that there was no reason to retain *fritillaria* even as a varietal name. Stiasny (1921; 1922), however, again separated *fritillaria* from *meleagris*, basing the distinction on form of the bell, number of marginal lappets and color, and especially on the form and size of the scapulettes which he considered a reliable anatomical character. More recently, however, he (Stiasny, 1931) has found from examination of excellent preserved specimens from British Guinea and Trinidad, that while extremes of the *"fritillaria"* and *"meleagris"* forms are far apart, all the characters formerly considered specific are so variable that he "der Bigelowischen Ansicht dass nur ein einziger ampla Species von Stomolophus besteht, nicht mehr so ablehnend gegenüber stehe als früher" (Stiasny, 1931, p. 175). The union of *meleagris* and *fritillaria* may therefore be allowed to stand, at least provisionally. Unfortunately, the present series does not afford any basis for the critical study that Stiasny (1922) thinks needful for eventual revision.

Stomolophus meleagris L. Agassiz.

Cephea rhizostoma, Gibbes, 1847, vol. 3, p. 183 (*non* Lamark, 1817).

Stomolophus meleagris, L. Agassiz, 1860, Pl. 14, Figs. 1-8; 1862, p. 138, 151; A. Agassiz, 1865, p. 40; Haeckel, 1880, p. 599; Mayer, 1910, p. 710, Pl. 75, Pl. 76, Figs. 1-3; Bigelow, 1914, p. 240; Stiasny, 1921, p. 170; 1922, p. 57; 1922a, p. 499; Boone, 1933, p. 48, Pl. 10.

Stomolophus agaricus, Haeckel, 1880, p. 599.

Stomolophus fritillaria, Haeckel, 1879, Pl. 35, Figs. 1-9; 1880, p. 598; Von Lendenfeld, 1884, p. 292; Vanhöffen, 1888, p. 31, 42; Stiasny, 1921, p. 170; 1922, p. 55; 1931, p. 175.

Stomolophus meleagris var. *fritillaria*, Mayer, 1910, p. 711.

Stomolophus chunii, Vanhöffen, 1888, p. 31, Pl. 3, Figs. 4, 5, Pl. 4, Fig. 1; Trinci, 1906, p. 1.

Brachiolophus collaris, Haeckel, 1880, p. 597 (juv.).

Material: Sta. 220, surface, 1 specimen about 23 mm. in diameter.

Sta. 219, 540-0 meters, 1 specimen about 40 mm. in diameter.

The larger of these specimens is at about the stage pictured by Mayer (1910, Pl. 75, Fig. 2). They do not add anything of importance to the accounts of the young stages given by him, and by Stiasny (1922a).

Pacific localities of record for *Stomolophus meleagris* had already included the Bay of Panama (Vanhöffen, 1888), the coast of Costa Rica (Haeckel, 1880, as *S. agaricus*), and southern California (Bigelow, 1914).

It was therefore to be expected in the waters traversed by the *Zaca*. The genus is so far known only from the two coasts of America, North and South, in low and mid-latitudes.

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